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Geology, Energy, and Mineral (GEM) Resource Assessment of the Petticoat Peak GRA, Idaho, including the Petticoat Peak (28-1) Wilderness Study Area

Bureau of Land Management
Contract No. YA-553-CT2-1039

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Geology, Energy, and Mineral (GEM) Resource Assessment of the Petticoat Peak GRA, Idaho, including the Petticoat Peak (28-1) Wilderness Study Area

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ANCHORAGE, ALASKA
JULY 1983

WGM INC.
MINING AND GEOLOGICAL CONSULTANTS

EXECUTIVE SUMMARY

The Petticoat Peak GRA is located near the town of Lava Hot Springs in southeastern Idaho. The GRA is in the Burley BLM district and includes one Wilderness Study Area (WSA) - Petticoat Peak (28-1).

The area is underlain by Cambrian to Mississippian limestones, dolomites and quartzites, and lesser amounts of young volcanic rocks. The extensively folded and faulted rocks are within the Rocky Mountain Thrust Belt, but the structural deformation exhibited within the Petticoat Peak GRA is more characteristic of Basin and Range structure farther west.

There are occurrences of manganese, limestone, quartzite and pumice in the Petticoat Peak GRA, and there are developed thermal springs at Lava Hot Springs. There are no mining claims in the WSA but all of it is covered by oil and gas leases.

The Petticoat Peak WSA has high potential for common varieties of limestone and quartzite, and moderate potential for hydrocarbons, manganese and uncommon varieties of limestone, quartzite and pumice. The WSA has low potential for metallic minerals other than manganese, non-metallic minerals, uranium, sodium and potassium. These classifications are summarized in the accompanying table.

GEM RESOURCES CLASSIFICATION

PETTICOAT PEAK WSA (28-1), IDAHO

			Classification
1.	Locatable		
	a.	Metallic Minerals	3B - manganese 2C - others
	b.	Uranium-Thorium	2B
	c.	Non-Metallic Minerals	3C
2.	Leasable Minerals		
	a.	Oil and Gas	3C
	b.	Low Temperature Geothermal	3B
		High Temperature Geothermal	2B
	c.	Sodium and Potassium	1C
	d.	Other	1C
3.	Saleable Resources		4D

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PETTICOAT PEAK GRA

1.0 INTRODUCTION

The Bureau of Land Management has adopted a two-phase procedure for the integration of geological, energy and minerals (GEM) resources data into the suitable/non-suitable decision making process for Wilderness Study Area (WSAs). The objective of Phase I is the evaluation of existing data, both published and available unpublished data, and evaluation of the data for interpretation of the GEM resources potential of the WSAs. Wilderness Study Areas are grouped into areas based on the geologic environment and mineral resources for the initial evaluation. These areas are referred to as Geology, Energy, Mineral Resources Areas (GRAs).

The delination of the GRAs is based on three criteria: (1) a 1:250,000 scale map of each GRA shall be no greater than 8½ x 11 inches: (2) a GRA boundary will not cut across a wilderness study area; and (3) the geologic environment and mineral occurrences. The data for each GRA is collected, compiled, and evaluated and a report prepared for each GRA. Each WSA in the GRA is then classified according to GEM resources favorability. The classification system and report format are specified by the BLM to maintain continuity between regions.

This report is prepared for the Bureau of Land Management under contract number YA-553-CT2-1039. The contract covers GEM Region 2; Northern Rocky Mountains (Fig. 1). The Region includes 50 BLM Wilderness Study Areas

totalling 583,182 acres. The WSAs were grouped into 22 GRAs for purposes of the Phase I GEM resources evaluation.

1.1 Location

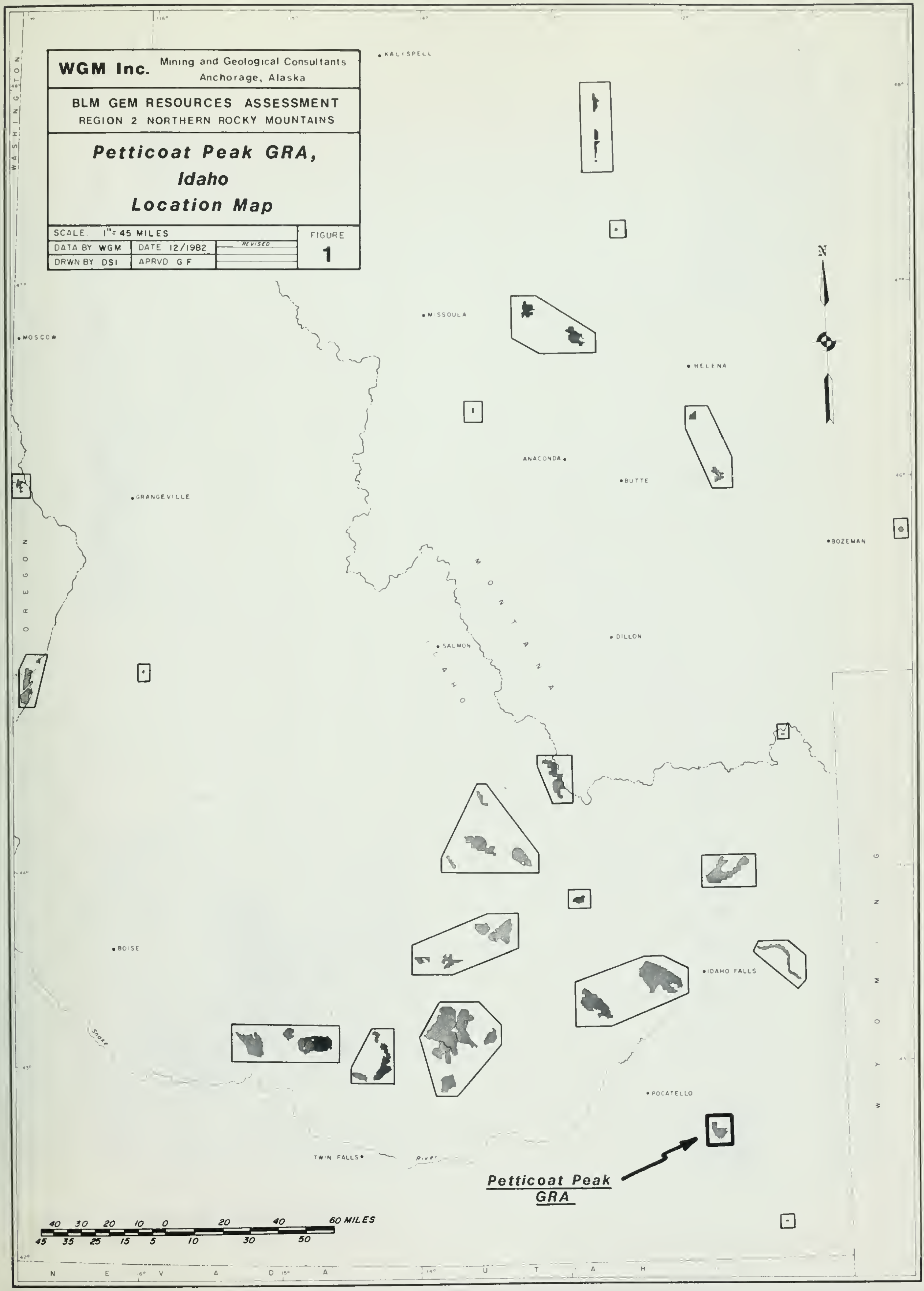
The Petticoat Peak GRA contains one Wilderness Study Area in Ts.8-9S., Rs.38-39E. comprising 11,298 acres in southeastern Idaho (Fig. 1 and 2). The GRA is in Bannock and Caribou Counties, and includes the town of Lava Hot Springs and the village of Bancroft. All of the WSA and most of the GRA is within the Bannock-Oneida Resource Area of the Burley BLM district, but the northeastern portion of the GRA is within the Soda Springs Resource Area.

1.2 Population and Infrastructure

Lava Hot Springs with a population of 467 is the largest community in the GRA. The area is 28 miles southeast of Pocatello (pop. 46,340), Idaho's second largest city. Access is via U.S. Highway 30N which passes through the western half of the GRA. The Union Pacific railway parallels U.S. 30N and the Portneuf River through the GRA. Several unimproved roads pass through the WSA in Hadley and North Canyons.

1.3 Basis of the Report

This report is based on a compilation, review and analysis of the available published and unpublished data on the geology, energy and mineral resources of the Petticoat Peak GRA. The GRA is in the Preston and Pocatello NTMS



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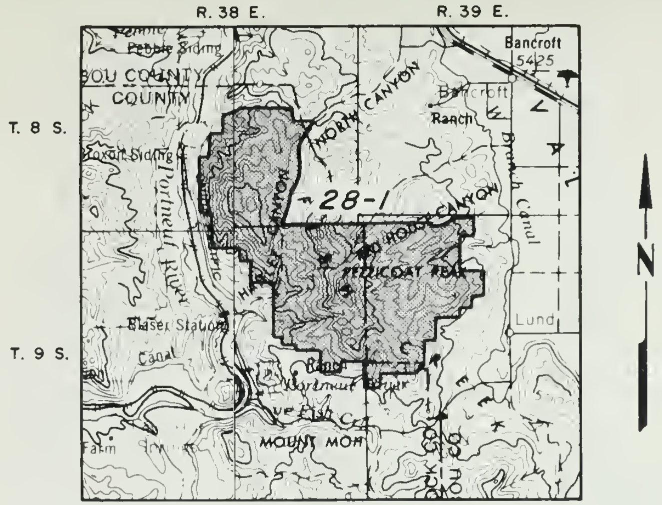
REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho Location Map

SCALE 1" = 45 MILES
DATA BY WGM
DATE 12/1982
REVISED
DRWN BY DSI
APRVD GF
FIGURE 1



BLM Wilderness Study Areas Included in the Petticoat Peak GRA.

WSA	NAME	ACREAGE
28-1	Petticoat Peak	11,298

▨ Approximate Boundary of Wilderness Study Area.

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Petticoat Peak, Idaho

Topographic Map

SCALE 1" = 4 MILES (1:250,000)			FIGURE
DATA BY. WGM	DATE 9/1982	REVISED	2
DRWN BY DSI	APRVD G F		

quadrangles and the area has been mapped by several authors; most notably S.S. Oriel (1968) and co-workers of the U.S. Geological Survey and Professor M.K. Corbett (1978) and his students at Idaho State University, Pocatello. In addition, a NURE study was conducted on the Pocatello quadrangle. BLM records of oil and gas leases and mining claims were reviewed and records of the Idaho Oil and Gas Commission were searched. Areal photographs, loaned to WGM by the BLM-Burley office, were examined.

The data were compiled and reviewed by WGM project personnel and the panel of experts to produce the resource evaluation which comprises this report. Personnel involved in the report preparation are listed below.

Greg Fernette, Senior Geologist, WGM Inc.	Project Manager
C.G. Bigelow, President, WGM Inc.	Chairman, Panel of Experts
Joel Stratman, Geologist, WGM Inc.	Project Geologist
Jami Fernette, Land and Environmental Coordinator, WGM Inc.	Claims and Lease Compilation

Panel of Experts

C.G. Bigelow, President, WGM Inc.	Regional geology, metallic and minerals, mineral economics.
R.S. Fredericksen, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
David Blackwell, Ph.D., Professor of Geophysics, Southern methodist University	Geothermal.
Jason Bressler, Senior Geologist, WGM Inc.	Regional geology, metallic minerals.
Gary Webster, Ph.D., Chairman, Department of Geology, Washington State University	Oil and gas.
William Jones, Senior Geologist, WGM Inc.	Metallic minerals, coal, industrial minerals.

J.F. McOuat, President, Watts, Griffis & McOuat Ltd.	Mineral economics, and industrial minerals.
E.F. Evoy, Senior Geologist, Watts, Griffis & McOuat Ltd.	Uranium and thorium.

1.4 Acknowledgements

We would like to thank Bob Gibson, BLM district geologist and Bill Boggs, wilderness coordinator, of the BLM-Burley office for their assistance in the compilation phase of the project and for the loan of publications and areal photos.

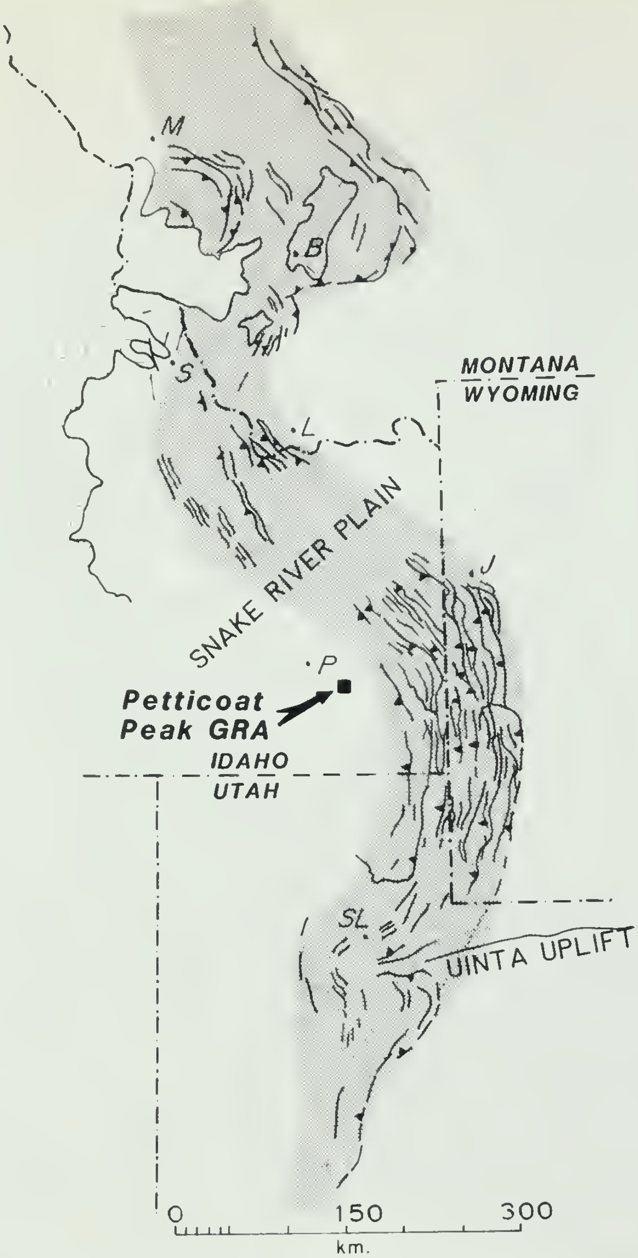
2.0 GEOLOGY

2.1 Introduction

The Petticoat Peak GRA is situated within the Portneuf and Fish Creek Ranges in the Idaho-Wyoming Overthrust Belt (Fig. 3). Rocks which underlie the area consist primarily of Paleozoic (600-230 m.y.) marine sedimentary rocks, Tertiary (65-2 m.y.) lacustrine and fluvial units, and basalts of Tertiary to Quaternary (2 m.y.-present) age (Fig. 6).

Paleozoic rocks consist of at least 8,000 feet of limestone, dolomite, shale, and quartzite comprising the Blacksmith, Bloomington, Nounan, St. Charles, Garden City and Swan Peak Formations, the Fish Haven, Laketown and Hyrum Dolomites, and Beirdneau and Lodgepole Limestones. Tertiary ash and conglomerate of the Salt Lake City and Starlight Formations unconformably overlie Paleozoic rocks. A basalt flow occurs within the Starlight and Salt Lake City Formations and a basalt flow of Pleistocene (2 m.y.-present) age occurs in the Portneuf valley (Fig. 5).

Portions of the GRA have been mapped by Corbett (1978), Oriel (1968), Schwarze (1960) and Mansfield (1929). The geology has been compiled by Rember and Bennett (1979). These maps show an intricate pattern of normally faulted Paleozoic strata exposed in the higher elevations and faulted Pliocene (6-2 m.y.) strata and unfaulted Quaternary sediments in the lower elevations and valley floors (Fig. 6).



Structural trends in the frontal Sevier orogenic belt, (stippled), Utah-Montana. Principal folds trends shown by lines; teeth on major thrust faults. M=Missoula; B=Butte; S=Salmon, L=Lima; P=Pocatello; J=Jackson; SL=Salt Lake City.

Data by: Beutner (1977)

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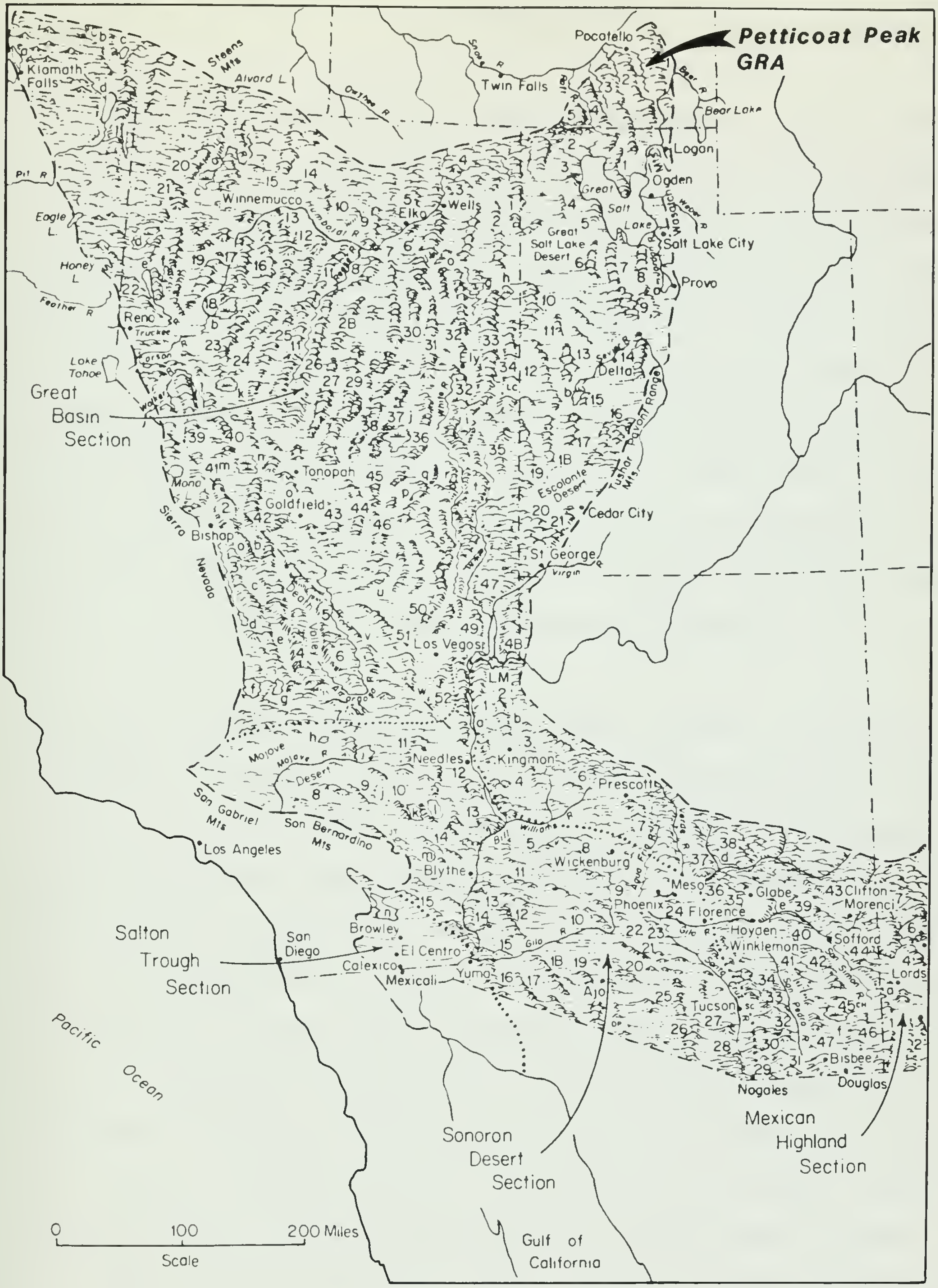
REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho
Regional Geologic Setting

SCALE AS SHOWN			FIGURE
DATA BY	DATE 12/1982	REVISED	3
DRWN BY DSI	APRVD G.F		



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Location of the Petticoat Peak GRA in the Basin and Range Physiographic Province (from Hunt, 1974).

SCALE AS SHOWN			FIGURE
DATA BY	DATE 1/83	REVISED	4
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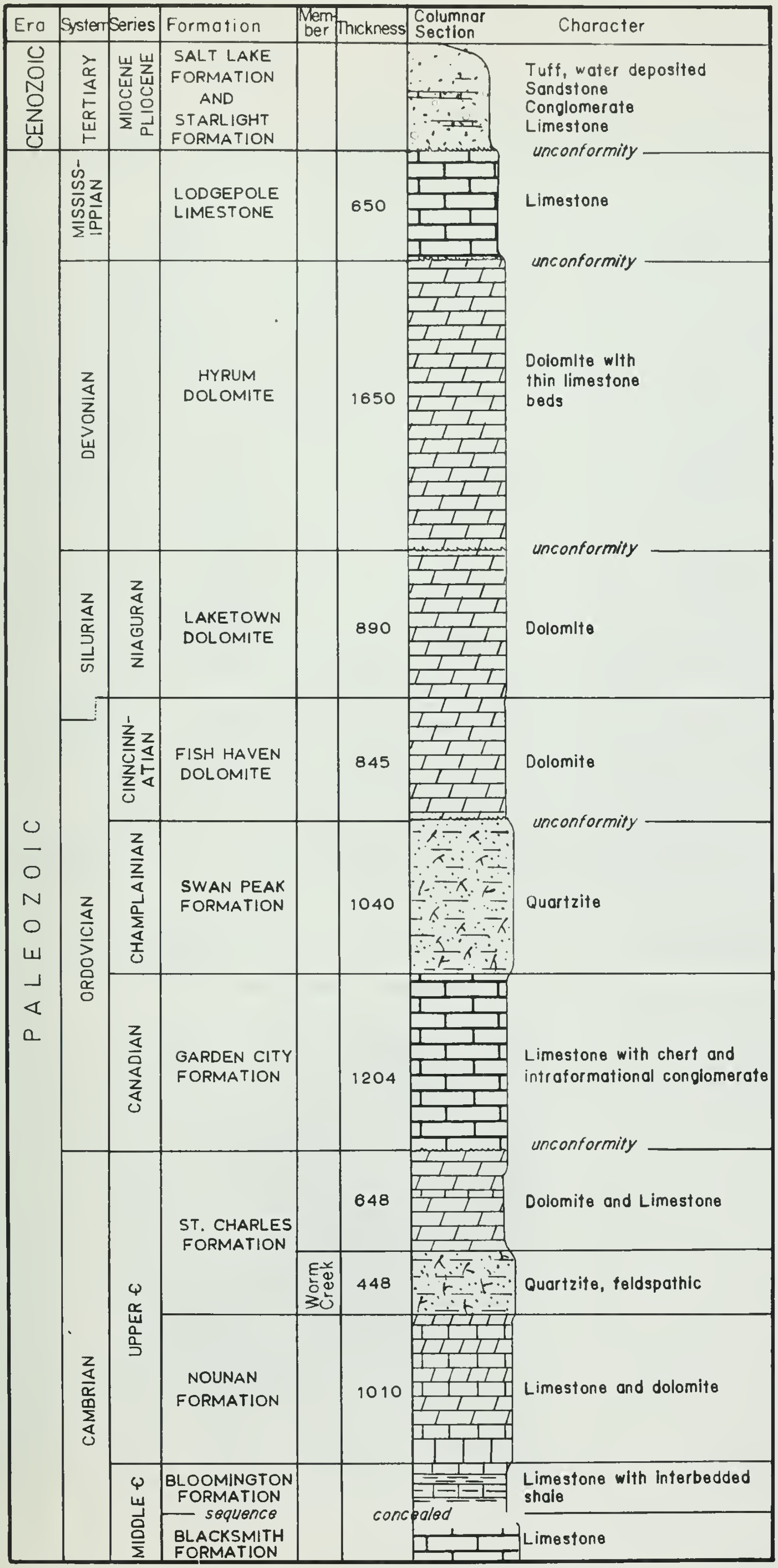
The stratigraphic section of the Portneuf Range, which includes the Petticoat Peak GRA, has not been described in detail. However, it lies between the Bannock Range to the west and the Bear River Range and other described sections in southeastern Idaho. The Paleozoic stratigraphy of the Bannock Range was described by Trimble and Carr (1976). They reported approximately 27,000 feet (8,229 m) of marine limestones, dolostones, quartzites, sandstones and shales of miogeoclinal origin. Mansfield (1927) reported a maximum of 16,165 feet (4,927 m) of Paleozoic and 27,580 feet (8,406 m) of Mesozoic (230-65 m.y.) strata in southeastern Idaho including parts of the Bear River Range. These strata consist of limestones, dolostones, sandstones, and mudstones and shales of miogeosynclinal origin.

The major differences between the stratigraphic sections of the Bannock Range and those farther east are: (1) the absence of the Mesozoic section and (2) a generally thicker Paleozoic strata to the west. According to regional geological mapping (Rember and Bennett, 1979; Mitchell and Bennett, 1979) Mesozoic strata are not recognized in the Petticoat Peak GRA. Most of the Paleozoic stratigraphy can be correlated in both areas and the stratigraphic section of Rember and Bennett (1979) is followed herein. Most of the stratigraphic names applicable to the Petticoat Peak area are catalogued by Pattison (1977) and many of these stratigraphic units have been discussed in summary regional studies of specific geologic intervals (Oaks et al., 1977; Loucks, 1977; Rose, 1977; several papers in Stewart et al., 1977; and several papers in Fouch and Magathan, 1980). Peterson (1977) constructed the palinspastic regional patterns for each Paleozoic period along the Rocky Mountain shelf and in the miogeosyncline of the Great Basin.



Era	System	Series	Formation	Member	Thickness	Columnar Section	Character
CENOZOIC	TERTIARY	MIOCENE PLIOCENE	SALT LAKE FORMATION AND STARLIGHT FORMATION				Tuff, water deposited Sandstone Conglomerate Limestone
							unconformity
PALEOZOIC	MISSISSIPPIAN		LODGEPOLE LIMESTONE		650		Limestone
							unconformity
	DEVONIAN		HYRUM DOLOMITE		1650		Dolomite with thin limestone beds
							unconformity
	SILURIAN	NIAGURAN	LAKETOWN DOLOMITE		890		Dolomite
	ORDOVICIAN	CINNCINNATIAN	FISH HAVEN DOLOMITE		845		Dolomite
							unconformity
		CHAMPLAINIAN	SWAN PEAK FORMATION		1040		Quartzite
		CANADIAN	GARDEN CITY FORMATION		1204		Limestone with chert and intraformational conglomerate
							unconformity
	CAMBRIAN	UPPER Є	ST. CHARLES FORMATION		648		Dolomite and Limestone
				Worm Creek	448		Quartzite, feldspathic
			NOUNAN FORMATION		1010		Limestone and dolomite
		MIDDLE Є	BLOOMINGTON FORMATION — *sequence*		*concealed*		Limestone with interbedded shale
			BLACKSMITH FORMATION				Limestone

Adapted from Schwartze (1960).

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REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho
Stratigraphic Column

SCALE 1"=1000' (APPROXIMATE)			FIGURE
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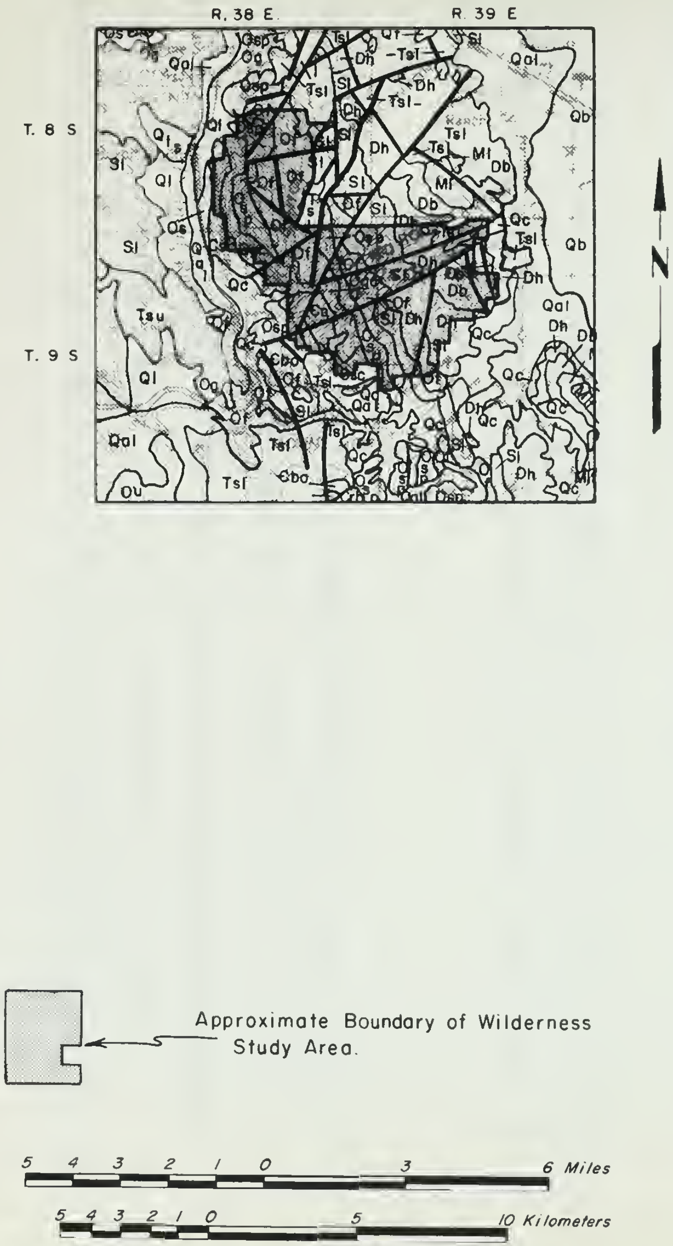

EXPLANATION

Sedimentary

Era	Symbol	Unit	Epoch	Period
CENOZOIC	Qal	Stream alluvium	Recent	Quaternary
	Qls	Landslide deposits		
	Ql	Loess		
	Qc	Colluvium		
	Tsu	Starlight and Salt Lake Formations, undifferentiated	Pliocene	Tertiary
	Tsl	Salt Lake Formation		
PALEOZOIC	Ml	Lodgepole Limestone	Mississippian	
	Db	Beirdneau Limestone	Devonian	
	Dh	Hyrum Dolomite		
	Sl	Laketown Dolomite	Silurian	
	Of	Fish Haven Dolomite		Ordovician
	Osp	Swan Peak Quartzite		
	Ou	Ordovician undifferentiated		
	Ogc	Garden City Formation		
	€sc	St. Charles Limestone		Cambrian
	€n	Nounan Limestone		
	€bo	Bloomington Limestone		
	€bl	Blacksmith Limestone		

Igneous

Symbol	Unit	Epoch	Period
Qb	Gentle Valley Group-Gem Valley Basalt	Pleistocene	Quaternary

——— FAULT

Data by: Rember and Bennett (1979).

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Petticoat Peak GRA, Idaho

Geologic Map

SCALE 1"=4 MILES			FIGURE
DATA BY	DATE 1/1983	REVISED	6
DRWN BY DSI	APRVD G.F		

2.2 Physiography

The Petticoat Peak GRA is situated at the extreme northeast corner of the Basin and Range physiographic province (Fig. 4; Hunt, 1974). Maximum elevation in the GRA is 8,033 feet at Petticoat Peak while the surrounding valleys are at elevations from below 5,000 to 5,400 feet. The present configuration of the mountain range and drainage is a result of block faulting and erosion. Resistant quartzite and dolomite units tend to form ridges and dip slopes and faults are responsible for exerting at least local control of some stream valleys. Vegetation consists of sagebrush and other scrub brush at low elevations while the higher elevations host aspen and conifers. Precipitation averages approximately 16 inches per year most of which falls during the winter months as snow and rain. Minimum-maximum temperatures average 8°F in mid-winter and 84°F in mid-summer (Ross and Savage, 1967).

2.3 Description of Rock Units

The stratigraphic section in the GRA is made up mainly of rocks of Cambrian (600-500 m.y.) to Mississippian (345-310 m.y.) age with a few Tertiary units (Figs. 5 and 6).

The Blacksmith Formation of Middle Cambrian (542-515 m.y.) age is the oldest rock exposed in the Petticoat Peak GRA. The formation crops out south of Fish Creek as a resistant thick bedded, medium-gray and medium-light gray limestone (Schwarze, 1960). In places the formation is dolomitic. Moderate-red silt partings are characteristic of some beds and pisolites up

to 1 inch (2.5 cm) in diameter weather out in relief in other beds. No diagnostic fossils are present and the age is determined by stratigraphic position.

The overlying Bloomington Formation consists of a thin-bedded, medium-gray limestone and flaggy and fissile, dark yellowish-brown shale. Schwarze (1960) reports nodules of limestone are common in the shale. Fragments of trilobites and brachiopods are present in some limestone units. The formation is weathers easily and good exposures are rare. An incomplete section is present in the GRA due to faulting (Corbett, 1978). The greatest thickness known in the Portneuf Range is 1,705 feet (520 m).

The Nounan Formation of Middle to Late Cambrian (515-500 m.y.) age consists of a basal assemblage of non-fossiliferous dark blue-gray, coarsely crystalline, medium to thinly bedded limestone which is oolitic and dolomitic in part and contains yellow and reddish silty partings. The basal assemblage grades upward into a highly distinctive massive pink to pinkish-gray finely crystalline dolomite and light to medium-gray dolomitic limestone (Corbett, 1978; Schwarze, 1960). Thickness of the formation is from 600 to 1,010 feet (185 to 310 m).

The Upper Cambrian St. Charles Formation consists of the basal Worm Creek Quartzite Member (Schwarze, 1960) and an upper unnamed dolomite member (Corbett, 1978). The Worm Creek Member of the St. Charles Formation consists of fine- to medium-grained feldspathic, quartzose, tan to yellow-tan sandstone and quartzite. The lower portion is dolomitic. The quartzite

beds of the Worm Creek form resistant ridgetop cappings and dip slopes. Thickness is 270 to 448 feet (80-135 m). The overlying dolomite member is medium dark to bluish gray, variably bedded with minor limestone which is coarsely crystalline (Corbett, 1978; Schwarze, 1960). Thickness of the upper member is 648 to 820 feet (200-250 m).

The Lower Ordovician (500-479 m.y.) Garden City Formation is a medium- to thick-bedded, blue to light gray limestone and dolomitic limestone which contains abundant intraformational limestone pebble conglomerate and bioclastic layers in the lower portion. Black chert bands and nodules are common, especially in the upper portion where chert may comprise up to 50% of the rock. The formation is highly fossiliferous when not heavily dolomitized (Corbett, 1978; Schwarze, 1960). Thickness ranges from 1,000 to 1,200 feet (305-365 m).

The Swan Peak Quartzite of Middle Ordovician (479-450 m.y.) age is a massive to thick-bedded white to light gray or tan quartzite with a basal zone of feldspathic sandstone about 100 feet (30 m) thick. The quartzite contains abundant fucoidal markings and weathered surfaces are commonly iron-stained (Corbett, 1978; Schwarze, 1960). Thickness varies from 675 to 1,040 feet (205-315 m).

The Upper Ordovician (450-435 m.y.) Fish Haven Dolomite unconformably overlies the Swan Peak. The Fish Haven is a fine- to medium-crystalline dolomite. The lower and middle portions of the formation contain abundant coral and brachiopod fossils and are massive dolomites with black chert. The upper part of the unit is thin- to medium-bedded with alternating gray

and lighter or mottled gray coarsely crystalline dolomite with some brachiopod and coral fossils (Corbett, 1978; Schwarze, 1960). Thickness is 845 to 890 feet (260-270 m).

The Silurian (435-395 m.y.) Laketown Dolomite is a coarsely crystalline dolomite consisting of a basal light gray, thin- to medium-bedded dolomite which grades upward into very light gray medium-bedded to massive dolomite. The lower contact with the Fish Haven Dolomite appears conformable and gradational. An incomplete section estimated at 890 feet (270 m) is present in the Petticoat Peak GRA (Corbett, 1978; Schwartze, 1960).

The Devonian (295-345 m.y.) Hyrum Dolomite which unconformably overlies the Laketown, is a thin- to medium-bedded, finely laminated, dark blue-gray finely to very finely crystalline, petroliferous smelling dolomite which weathers to a dull brown. It contains numerous beds of light gray, thin- to thick-bedded dolomite and some thin beds of light gray subaphanitic limestone (Oriel, 1968). Thickness is 1,650 feet (503 m).

The Mississippian (345-310 m.y.) Lodgepole Limestone is a medium-gray, thin- to medium-bedded limestone. It is a coarsely bioclastic and coquinoid to very finely crystalline limestone containing numerous layers of dark gray chert (Oriel, 1968). Mississippian age limestones constitute reservoir rocks for oil and gas deposits in the Rocky Mountain Thrust Belt (Powers, 1977). Thickness is 650 feet (198 m).

Unconformably overlying the Paleozoic section are the Tertiary Salt Lake and Starlight Formations. The age of the formation is Pliocene and in part

Miocene (23-6 m.y.). The Salt Lake City Formation consists of unconsolidated to poorly consolidated conglomerate, valley-fill gravel, lacustrine sand and clay, water laid tuffs, and limestone interbedded with volcanics consisting of rhyolitic, andesitic, and basaltic tuffs, agglomerates, and flows belonging to the Starlight Formation (Corbett, 1978; Oriel, 1968; Schwarze, 1960). Thickness is quite variable but is at least several hundred feet (60 m). Pumice is mined from the Salt Lake Formation at some locales (Strowd et al., 1981).

Extensive Quaternary basalts and rhyolites occur in the Gem Valley and the Blackfoot Reservoir area and in the Portneuf Valley which is within the Petticoat GRA, immediately to the west of the Portneuf Range. The basalt flows are both younger and older in age than 700,000 years, as indicated by the presence of both older reversely magnetized basalts and younger normally magnetized basalt flows (Mitchell, 1976). The flows are black, highly vesicular, and contain phenocrysts of plagioclase and olivine and display good columnar jointing (Corbett, 1978). Accumulations of cinder from the basaltic volcanics are mined in some locales (Strowd et al., 1981). Rhyolite domes in the Blackfoot Reservoir area have been dated at about 1½ m.y. (Evans, 1980). Quaternary basalt is exposed along the valley of the Portneuf River and may come from vents near Alexander, Idaho, about 10 miles east of the GRA. The basalt extends as far as Pocatello, about 30 miles to the northwest. The age of the basalt is about 34,000 years (Ives et al., 1964).

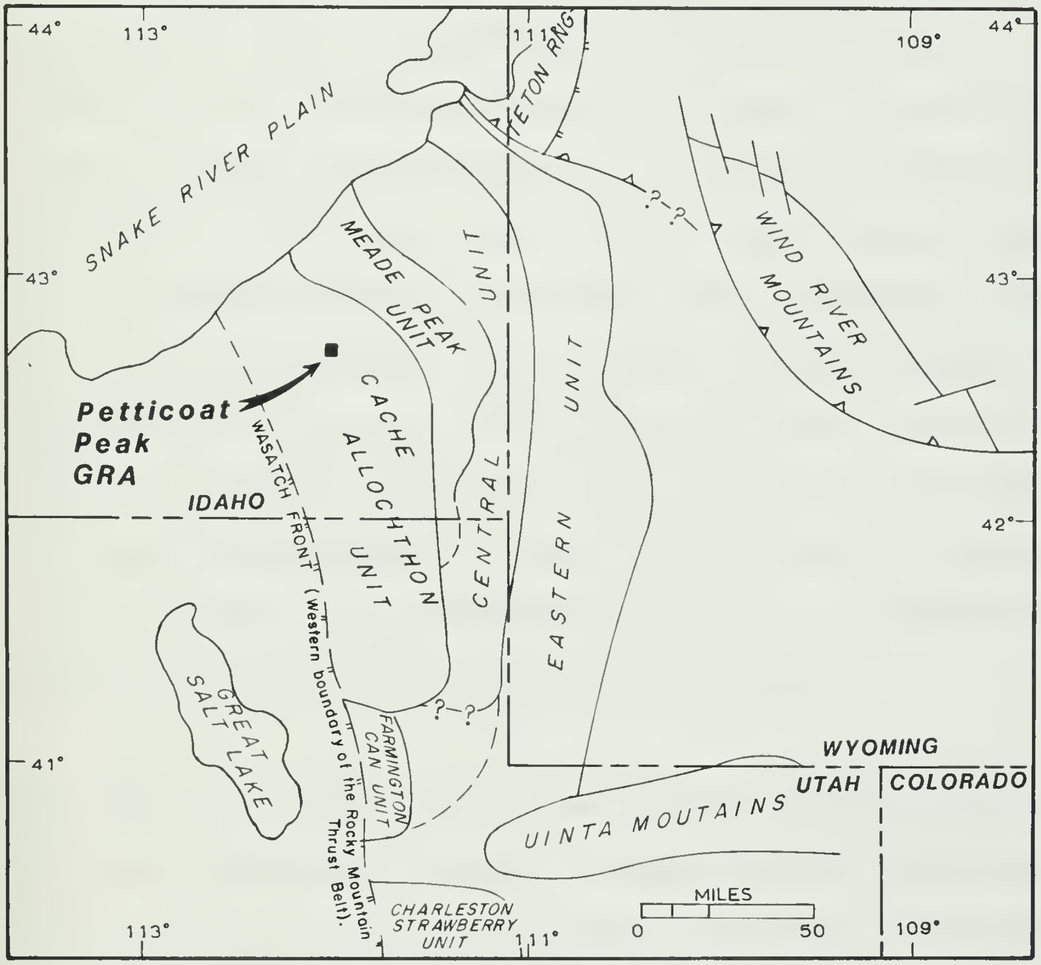
Travertine is presently being deposited by the thermal springs for which the town of Lava Hot Springs is named. Older travertine deposits are present at

several places along the Portneuf River valley and are responsible for many of the waterfalls and rapids along the Portneuf River. The travertine is pale yellowish brown, generally with a spongy texture. These deposits can be related to major faults in the area (Schwarze, 1960).

Quaternary deposits of colluvium, loess, landslide deposits, and stream alluvium occur along the Portneuf valley, along the flanks of Gem valley, and in the Fish Creek Basin. Sand and gravel deposits are mined at many locales throughout the Portneuf-Bear River drainages.

2.4 Structural Geology and Tectonics

The Petticoat Peak GRA is situated within the western portion of the Rocky Mountain Thrust Belt (Fig. 7). It is within the Cache Allochthon (Blackstone, 1977) segment which bounds the frontal thrust belt lying between east-central Utah and west-central Montana. The frontal thrust belt is referred to by Beutner (1977) as the Sevier orogenic belt (Fig. 3). Southeastern Idaho has been recognized by many authors as part of the Cordilleran (Rocky Mountain) Thrust Belt (King, 1969; Blackstone, 1977; among others). This area includes several major thrust faults, open to overturned folds, and major block faults (Mansfield, 1927; Blackstone, 1977). The tectonic history of the Overthrust Belt was summarized by Armstrong and Oriel (1965) and modeled by Jordan (1981). According to Royse et al. (1975) the age of thrusting is Late Jurassic (158-141 m.y.) to Paleocene (65-55 m.y.), whereas the block faulting is post-thrust faulting (Blackstone, 1977).



DATA BY: BLACKSTONE, (1977)

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Anchorage, Alaska

BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho
Regional Structural Setting

SCALE AS SHOWN
DATA BY.
DATE 12/1982
REVISED
DRWN BY DSI
APRVD G.F

FIGURE
7

The Cache Allochthon (Fig. 7) also known as the Paris Allochthon (Allmendinger, 1981) lies west of the trace of the Willard-Woodruff-Paris thrust fault which marks the boundary of the Sevier orogenic belt, and probably underlies the area to the west and southwest of the Great Salt Lake. The allochthon is displaced downward to the west along the Wasatch front fault; thus, its western extent is not exposed. The rocks in the allochthon include a thin basalt unit of phyllic schist 1.4 to 1.6 by in age overlain by Late Precambrian (800-600 m.y.) Huntsville Group rocks, a thick section of Early Cambrian (600-542 m.y.) rocks, and a modestly thick section of early and late Paleozoic rocks ranging in age to Permian (280-230 m.y.). Only the Middle Cambrian to Mississippian rocks are exposed in the Petticoat Peak GRA. The allochthon is broadly folded along with the underlying westward dipping thrust fault in the region east of Ogden, Utah and its eastern margin is strongly folded near Bear Lake, Utah (Blackstone, 1977). The allochthon extends northward to the vicinity of Pocatello, Idaho where it includes a thick section of Precambrian Z rocks. Its southern boundary is marked by the edge of the Farmington Canyon Complex.

The frontal Sevier thrust belt is characterized by a terrane of decollement thrusting to the west. Folding is a common structural feature within the Sevier belt to the east but for the most part it only affects strata that are above the decollement surfaces and does not affect the basement. The folds are most commonly asymmetric to the east although local variations do occur (Blackstone, 1977).

The youngest faults in the Rocky Mountain Thrust Belt are high angle normal faults which displace late Cenozoic sediments of the Salt Lake Formation and

equivalent age rocks (Blackstone, 1977). Royse et al. (1975) propose that the major movements of the normal faults with large displacement occurs on the listric surface concave upward which at depth merges into an older underlying west dipping thrust fault. The motion on the hangingwall block of the normal fault is rotational. This model is adequate where a single normal fault or fault system bounds one side of a depressed segment, but the model does not provide a satisfactory explanation of structural development in a situation like that in the Gem Valley where a downthrown block is bounded on both sides by subparallel normal faults. Blackstone (1977) suggests that as Basin and Range style deformation first extended eastward, faulting followed the model proposed by Royse et al. (1975), but as the degree and magnitude of normal faulting increased, particularly along the Wasatch front fault, it extended through the allochthonous rocks into the underlying basement.

Within the Petticoat Peak GRA, the most prominent structural feature is a group of north trending normal faults related to the Basin and Range type deformation of Late Cenozoic rocks discussed above. These faults are not often exposed, but their existence is likely based on stratigraphic displacement and repetition of the east-dipping Paleozoic formations. Displacement of fault traces by topography is not conspicuous; therefore, the faults ar eprobably high angle. When exposed, the faults dip steeply west. The fault trace is characteristically arcuate and locally the structure is complicated by branching into two or more faults (Fig. 6) of less displacement. The downthrown side of large faults is the west and displacement is as much as 6,600 feet with total displacement of combined faulting exceeding

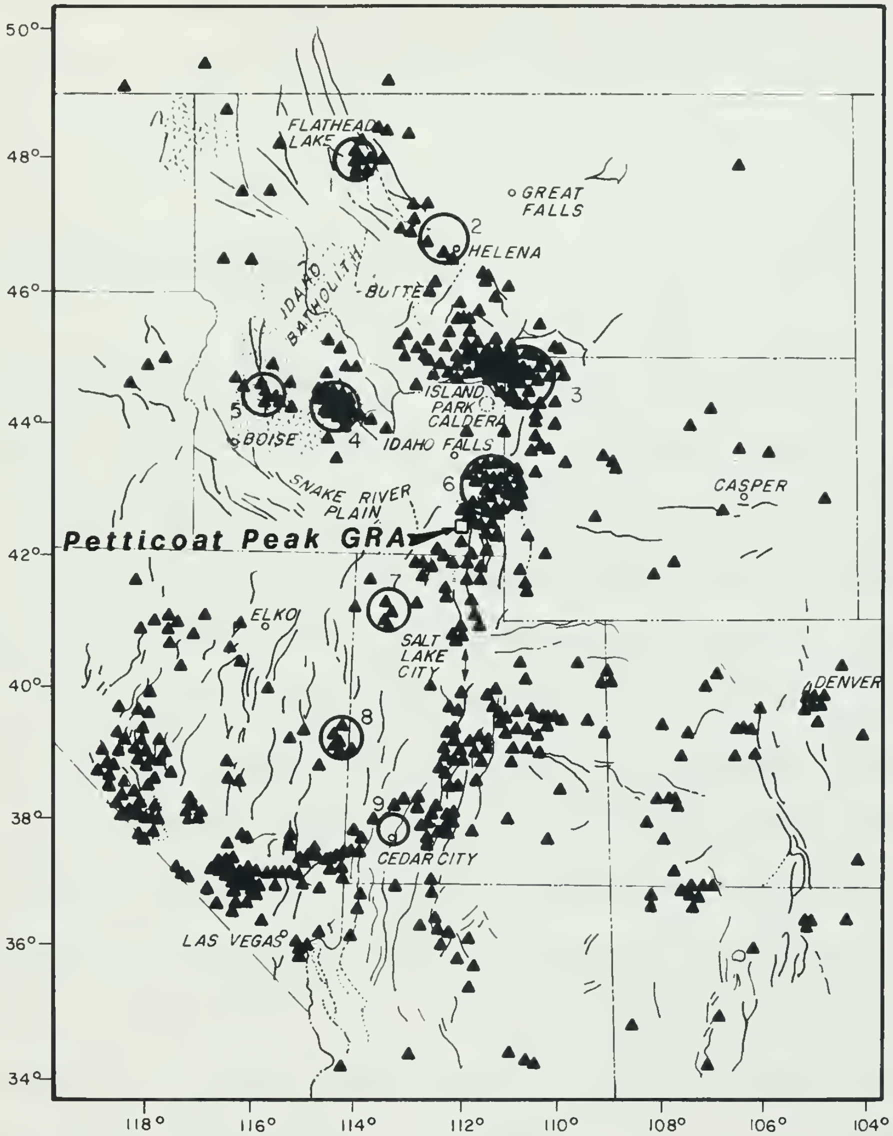
25,000 feet. A second set of faults, of less displacement and characterized by left-lateral movement, trends N80°E. These faults are very common in the Fish Creek Range (Schwarze, 1960). In many places this fault activity has continued to Holocene (0.1 m.y. to present) time as evidenced by fault scarps displacing alluvial fans. Present seismic activity further documents present-day movement along faults within the region (Smith, 1978). On the basis of gravity data the Gem Valley is interpreted as a major northwest trending graben which contains thick accumulations of Tertiary sedimentary units (Mabey and Oriel, 1970).

The normal faults are responsible for the localization of deposits of manganese oxides in brecciated dolomite near Lava Hot Springs and have acted as channelways for thermal springs depositing travertine (Hewett et al., 1963).

Geologic hazards which exist in the Petticoat GRA are related to seismic activity. The GRA is within a seismically active area known as the Intermountain Seismic Belt (Smith and Sbar, 1974), a north-trending zone of high seismic activity in the western United States (Fig. 8). Seismic activity within this Belt is characterized by shallow earthquake focal depths believed to be caused by an east-west extensional subplate tectonic regimen. The most significant historic seismic event in the Belt was the 1959 Hebgen Lake earthquake with a magnitude of 7.1.

2.5 Paleontology

No systematic paleontological investigations have been conducted within the Petticoat Peak GRA. Although fossils are present throughout much of the



EPICENTERS FOR INTERMOUNTAIN SIESMIC BELT SHOWING ALL EARTHQUAKES REPORTED BY NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) OF ABOUT MAGNITUDE 3.0 OR GREATER FROM 1961 THROUGH 1970. DOUBLE ARROW SHOWS ZONE OF LOW SIESMICITY. CIRCLES MARK EARTHQUAKE SWARMS: 1, FLATHEAD LAKE, MONT.: 2, HELENA, MONT.: 3, YELLOWSTONE PARK: 4, SAWTOOTH RANGE, IDAHO: 5, IDAHO BATHOLITH: 6, CARIBOU RANGE, IDAHO 7, GREAT SALT LAKE DESERT, UTAH 8, LEHMAN CAVE MONUMENT, NEVADA: 9, CEDAR CITY, UTAH.

DATA FROM SMITH AND SBAR (1974)

0 70 140 210 MILES
SCALE APPROXIMATE

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REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho

Regional Seismicity

SCALE AS SHOWN			FIGURE
DATA BY	DATE 1/1983	REVISED	8
DRWN BY DSI	APRVD G.F.		

Paleozoic section, good faunal assemblages are not common and individual specimens are commonly poorly preserved (Schwarz, 1960; Corbett, 1978; Oriel, 1968). Enough fossils are present to aid in mapping and the determination of rock units but no noteworthy paleontological sites are known to be present.

2.6 Historical Geology

The depositional history of the area begins about 850 million years ago as Precambrian strata were deposited in an epicratonic trough or troughs from continental sources to the east. This was followed by formation of an extensive miogeosyncline which developed along the entire length of the cratonic margin and in which a thick sequence of sediments accumulated. Depositional was continuous in places from late Precambrian to Early Cambrian and the miogeosyncline existed as a depositional site throughout lower Paleozoic time. In southeastern Idaho by the end of Permian time, approximately 35,000 feet of Paleozoic strata, principally carbonate had accumulated in the miogeosyncline. The Paleozoic units in the trough are generally continous with deposits of the same age on the shelf to the east. At the hinge line of the trough near what is now the Idaho-Wyoming border, however, the pre-Tertiary strata accumulated to less than 12,000 feet primarily due to the pinchout of Early Cambrian rocks against the edge of the trough (Blackstone, 1977). During lower Mesozoic time the site of deposition in the miogeosynclinal trough was about the same as earlier.

The site of major deposition began to shift eastward during the Triassic since the thickest sections of Triassic rocks were deposited slightly east of the sites of maximum Paleozoic accumulation. Orogenic uplift associated with the Sevier orogenic event in northeast Nevada and northwestern Utah accelerated this eastward shift. The depositional pattern changed drastically by Jurassic time as the major site of deposition continued its eastward shift during Jurassic and Cretaceous time when thick locally coarse clastics were deposited in what is now the eastern part of the Rocky Mountain Thrust Belt (Blackstone, 1977). These sediments are believed to be the source rocks for several of the oil and gas deposits within the Overthrust Belt (Powers, 1977).

The result of deposition beginning about 850 million years ago and ending in the Cretaceous was formation of a wedge-shaped prism of sediments on a basement complex 1.6 billion years old or older. The western edge of the miogeosynclinal prism was as much as 60,000 feet thick while total thickness attained along the hinge line was about 12,000 feet. Parameters which were to influence the localization of thrust faults during later deformation include variation within the sedimentary prism (i.e. limestone versus shale); the surface configuration of the older Precambrian basement; the extent and volume of sediments; and the distribution of fluid pressures (Blackstone, 1977).

Deformation of the miogeosynclinal prism was initiated during the Sevier orogeny which began by latest Jurassic time (Royse et al., 1975; Beutner, 1977). The first thrust plate in the Overthrust Belt of Idaho-Wyoming-Utah to be activated was the Cache Allochthon as indicated by the deposition of

thick synorogenic conglomerates belonging to the Ephraim of Late Jurassic and Early Cretaceous age (Armstrong and Oriel, 1965). Deformation shifted eastward with time progressively involving the Meade Peak, central, and eastern allochtons as older thrust faults "piggy-backed" on the youngest (Paleocene) thrusts (Blackstone, 1977).

Basin and Range block-faulting began in the mid-Tertiary and has continued to the Holocene, a manifestation of an extensional tectonic regimen. Graben structures (such as Gem Valley) formed deep basins as a result of the normal faulting. Subsequently these basins were filled with thick accumulations of Tertiary sediments (Blackstone, 1977).

Volcanic activity became widespread in the Pliocene producing deposits of ash and volcanic flows (Ives et al., 1964; Evans, 1980). The area continues to be one of high heat flow as indicated by the presence of thermal springs such as those located at Lava Hot Springs (Mitchell et al., 1980). The processes associated with faulting and thermal activity controlled the manganese deposition locally found in the GRA and surrounding areas (Hewitt et al., 1963).

3.0 ENERGY AND MINERAL RESOURCES

3.1 Introduction

Data on known energy and mineral deposits was compiled through a review of all available data. Principal sources were the U.S. Bureau of Mines MILS Data File, the USGS CRIB File, and publications by Strowd et al. (1981) and Mitchell et al. (1981). The Petticoat Peak GRA contains deposits and occurrences of manganese, sand and gravel, cinder, silica, limestone, dolomite, and thermal springs. It has potential for oil and gas (Table I, Fig. 9). A limestone deposit 15 miles northwest of the GRA at Inkom is mined for use in production of portland cement (Nygaard, 1982).

3.2 Known Mineral and Energy Deposits

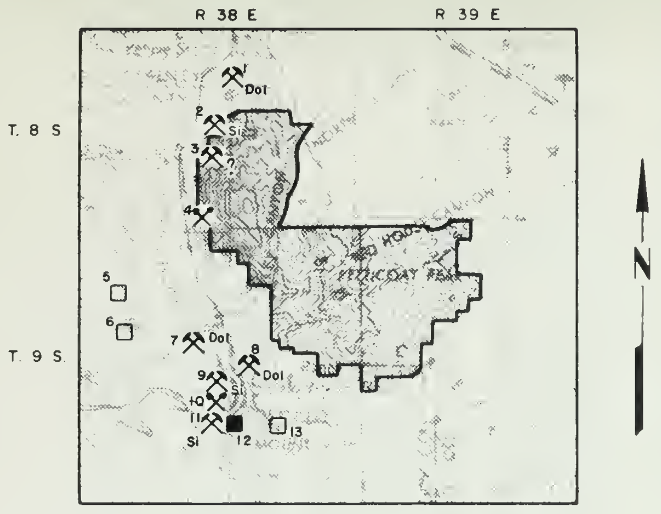
No mineral or energy deposits are known to occur in the Petticoat Peak WSA.

The Petticoat Peak GRA contains one deposit of manganese (the Vanza Mine) near Lava Hot Springs (Fig. 9, No. 12). According to Hewett et al. (1963) the Vanza Mine is located on the steep south slope of the Portneuf valley about 450 feet above the river. Several adits explored a deposit of manganese oxides containing about 35 percent manganese and 12 percent silica. The mine workings explored a breccia 10 to 15 feet wide in which nearly pure manganese oxide was deposited. The manganese oxide was probably deposited by spring waters that rose along a fault in the Paleozoic rocks. Extended northward, the zone explored by the mine meets the Portneuf River at Lava Hot Springs. It appears that the manganese oxide was deposited in

TABLE I

MINERAL DEPOSITS, PROSPECTS AND OCCURRENCES OF THE PETTICOAT PEAK GRA

Map No.	Name	Location			Commodity		
		Sec.	T.	R.			
1	Garden City Dolomite	15	8S	38E	Dol	Mg	Strowd et al. (1981)
2	Wonder Insulation Building Stone Quarry	22	8S	38E	Sil	Al	" "
3	Unnamed Quarry	28	8S	38E			" "
4	Unnamed	33	8S	38E	Sand, Gravel		
5	Unnamed Prospect	7	9S	38E	No data		" "
6	Unnamed Prospects	17	9S	38E	No data		" "
7	Laketown Dolomite	16	9S	38E	Dol	Mg	" "
8	Fish Haven Dolomite	15	9S	38E	Mg		" "
9	Sunday Group	21,22	9S	38E	Sil		" "
10	Sand and Gravel	21	9S	38E			" "
11	Saturday Group Occurrence	21,28	9S	38E	Sil		" "
12	Vanza Mine	22,27	9S	38E	Mn		USBM-MILS; Hewett et al. (1963); and Lickes and Nicalson (1956)
13	Lava Hot Springs	26	9S	38E	Mn		Mitchell et al. (1981)



LEGEND

■ Mineral Orebody

◧ Mineral Deposit

□ Mineral Occurrence

⚒ Quarry

⚒ Gravel or clay pit

1 □ —occurrence number

5 ⚒ —occurrence number
Dol —commodity

Si = Silica
Dol = Dolomite

▨ Approximate Boundary of Wilderness Study Area.

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Petticoat Peak GRA, Idaho

Mineral Deposits and Occurrences

SCALE 1"=4 MILES			FIGURE
DATA BY WGM	DATE 1/1983	REVISED	9
DRWN BY DSI	APRVD G.F		

the breccia when the bed of the Portneuf River was located at the same elevation as the manganese deposit.

Exploration of the Vanza Mine during 1953-54, including new drifting and cross-cutting on the lower workings, showed that manganese ore consisting of wad with a small amount of psilomelane, occurs in a 20 to 25 foot thick, highly brecciated quartzite bed. The quartzite breccia occurs within a dolomite sequence and extensive leaching is evident in both the footwall and hangingwall of the breccia. The ore occurs within the breccia in small pods and lenses. The work in the early 1950s did not result in the discovery of sufficient reserves for a profitable operation and the possibility of making a major discovery is meager. Production from the Vanza Mine through 1954 is estimated at between 4,000 and 5,000 tons of ore (Lickes and Nickalson, 1956).

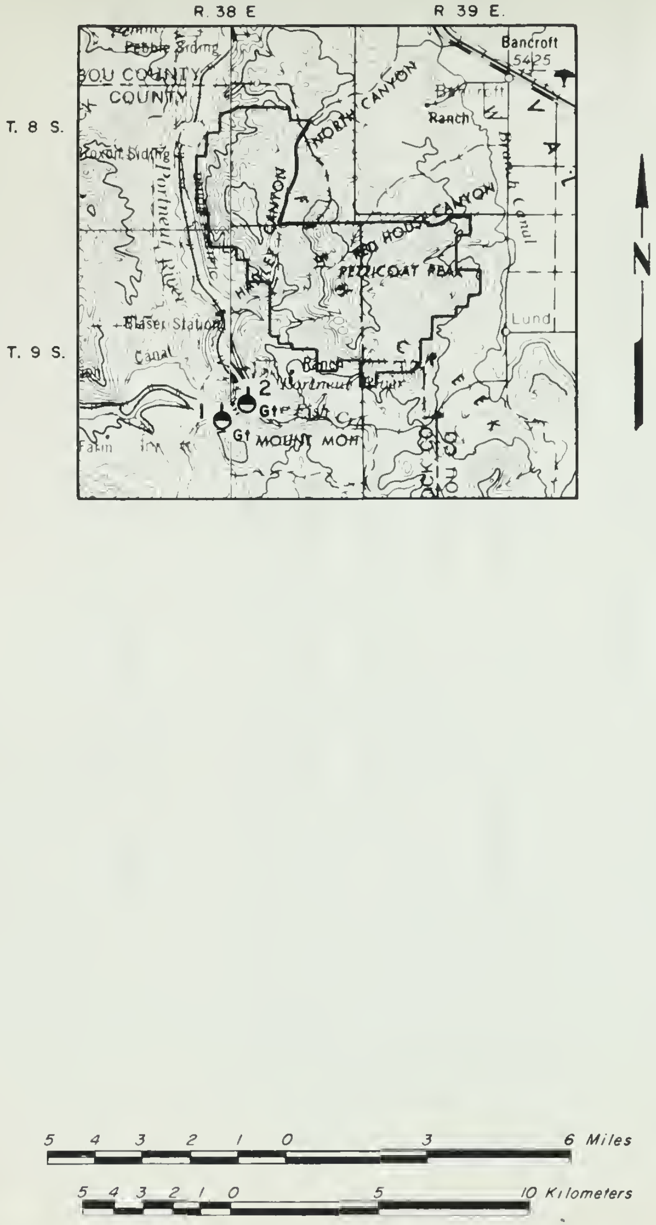
Sand and gravel deposits have been exploited along the Portneuf River valley and stone has been quarried at two locations (Fig. 9, Nos. 2 and 3).

Two groups of thermal springs are present at Lava Hot Springs (Fig. 10, Table II). These springs are presently used for recreational purposes and are being evaluated for use in space heating (Mitchell et al., 1980). The springs issue from numerous vents in basalt which underlies the Portneuf River Valley (Ross, 1971). Extensive travertine deposits and some manganese mineralization are associated with the springs (McLain, 1978; Hewitt et al., 1963). The springs occur at the intersection of the north-south trending fault which bounds Portneuf Valley and an east-west trending linear (McLain,

TABLE II

THERMAL SPRINGS IN THE PETTICOAT PEAK GRA, IDAHO

Map No.	Name	Location			Surface Temp. (C^o)	Flow Rate (1/m)	Total Dissolved Solids	Specific Conductance	Estimated Reservoir Temp. (C^o)		Source of Data
		Sec.	T.	R.					Na-K-Cu	Si	
1	Lava Hot Springs	21	9S	38E	45	1,500	960	1,579	211	80	Young & Mitchell, 1973
2	Lava Hot Springs	22	9S	38E	45	ND	ND	ND	ND	ND	McLain, 1978



LEGEND

- ● oil well
- ✹ oil and gas well
- ☼ gas well
- ☼ well with show of gas
- ● well with show of oil
- ✹ well with show of oil and gas
- ⌀ shut in well
- ✧ dry hole — abandoned
- ○ tight hole or well in progress as of July, 1982
- ◌ O Oil field
- ◌ G Gas field
- ◌ OS Oil shale
- ◆ O Oil show or seep
- ⬢ C Coal deposit
- ⬡ C Coal occurence
- ◐ Gt Thermal water
- ◌ Gt Geothermal area
- ☐ U Uranium occurence / deposit
- ☐ Th Thorium occurence / deposit

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REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho

Energy Resource
Occurrence Map

SCALE 1" = 4 MILES (1 250,000)			FIGURE
DATA BY W G M	DATE 9/1982	REVISED	10
DRWN BY DSI	APRVD G. F		

1978; Day, 1974; Haskett, 1976). Fault breccias are found near the springs (Stearns et al., 1938). The thermal waters appear to rise along the steeply dipping fault zones and spread horizontally along the base of the basalts (McLain, 1978). The temperature of the springs ranges from 21° to 68°C and averages 40°C with a flow rate of 1,500 gpm (Young and Mitchell, 1973). The estimated subsurface temperature ranges from a minimum of 50°C using the chalcendony geothermometer to a maximum of 80° using the quartz geothermometer (Mitchell et al., 1980).

3.3 Known Mineral and Energy Prospects, Occurrences, and Mineralized Areas

No mineral or energy occurrences are reported in the Petticoat Peak WSA.

Within the GRA, Mitchell et al. (1981) report a manganese occurrence (Fig. 9, No. 13) one mile east of the Vanza Mine. No data is given, but it is most likely in a setting similar to the Vanza Mine. Two other unnamed prospects (possibly manganese?) are reported by Strowd et al. (1981) but no information is given (Fig. 9, Nos. 5 and 6).

Quarries occur within three dolomite units - the Garden City, Fish Haven, and Laketown formations (Fig. 9, Nos. 1, 7 and 8). Likewise, quarries for silica are present in some exposures of quartzite (Fig. 9, Nos. 9 and 11). Finally, Strowd et al. (1981) report two additional sand and gravel occurrences (Fig. 9, Nos. 4 and 10) for which no information is available.

There are no uranium occurrences in the GRA (Cook, 1980).

No oil and gas wells have been drilled in the GRA, although much of the area is covered by oil and gas leases (Fig. 11) and seismic lines have been run in the area (R. Gibson, personal communication, 1982).

3.4 Mining Claims, Leases, and Material Sites

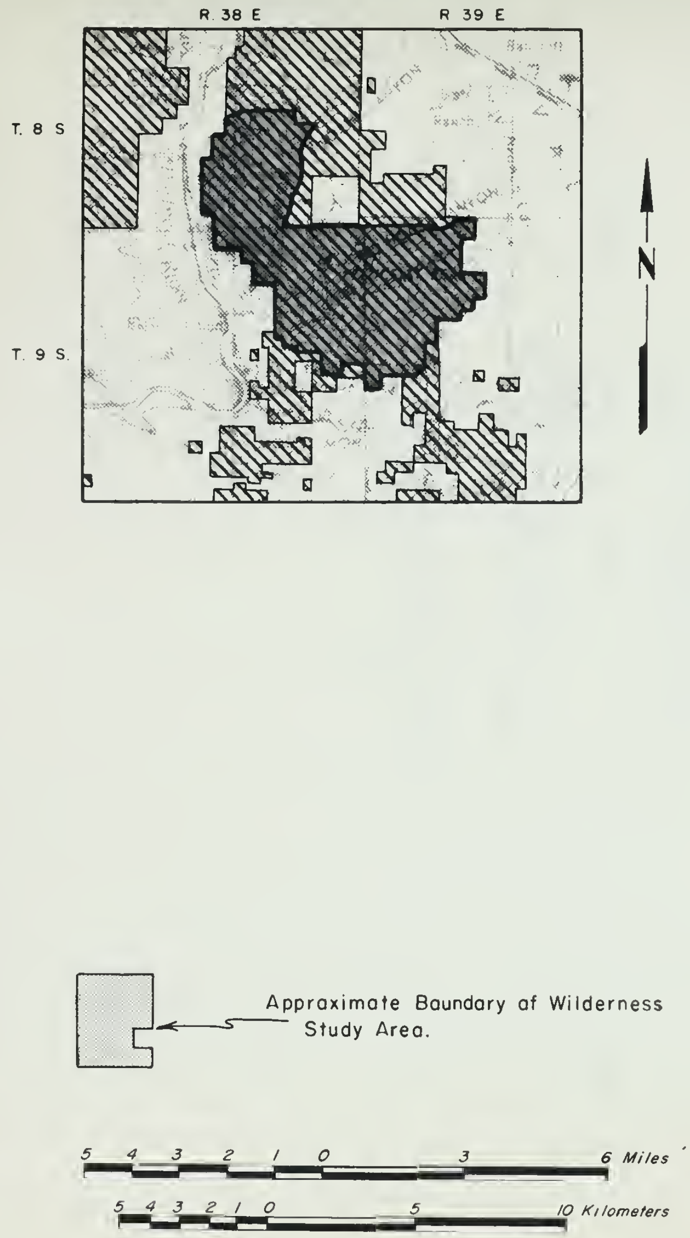
A review of BLM mining claims records and mineral title plats shows that there are no patented or unpatented mining claims in the Petticoat Peak GRA as of June 7, 1982. There are five material sites in the GRA (Fig. 12), however none are in the WSA.

Approximately 50% of GRA, including all of the WSA 28-1, is covered by oil and gas leases (Fig. 11). The majority of these leases were issued in 1981 and are owned by Mr. Thomas D. Hewitt (Table III).

3.5 Mineral and Energy Deposit Types

Based on the geologic environment and mineral and energy occurrences in the Petticoat Peak GRA there appear to be eight deposit types which would serve as models for evaluation of the WSA. These are: sand and gravel, quarry stone, silica, limestone and dolomite, manganese, uranium, geothermal, and oil and gas. The overall geologic environment does not appear to be favorable for metallic mineral deposits; however, there is no geochemical or other data available on which to base a complete evaluation.

The majority of sand and gravel deposits are in alluvial terraces above the level of the Portneuf River and Fish Creek. There is little alluvium in the Petticoat Peak WSA.


R. 38 E
R 39 E
T. 8 S
T. 9 S.
N
Appraximate Baundary af Wilderness Study Area.
5 4 3 2 1 0 3 6 Miles
5 4 3 2 1 0 5 10 Kilometers

LEGEND

▧ Area covered by oil and gas leases.

▨ Area covered by oil and gas lease application.

Notes: 1) Area of Search: Entire GRA
2) Data current to: Aug. 8, 1982
3) Source of Data: BLM OG Plats

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho

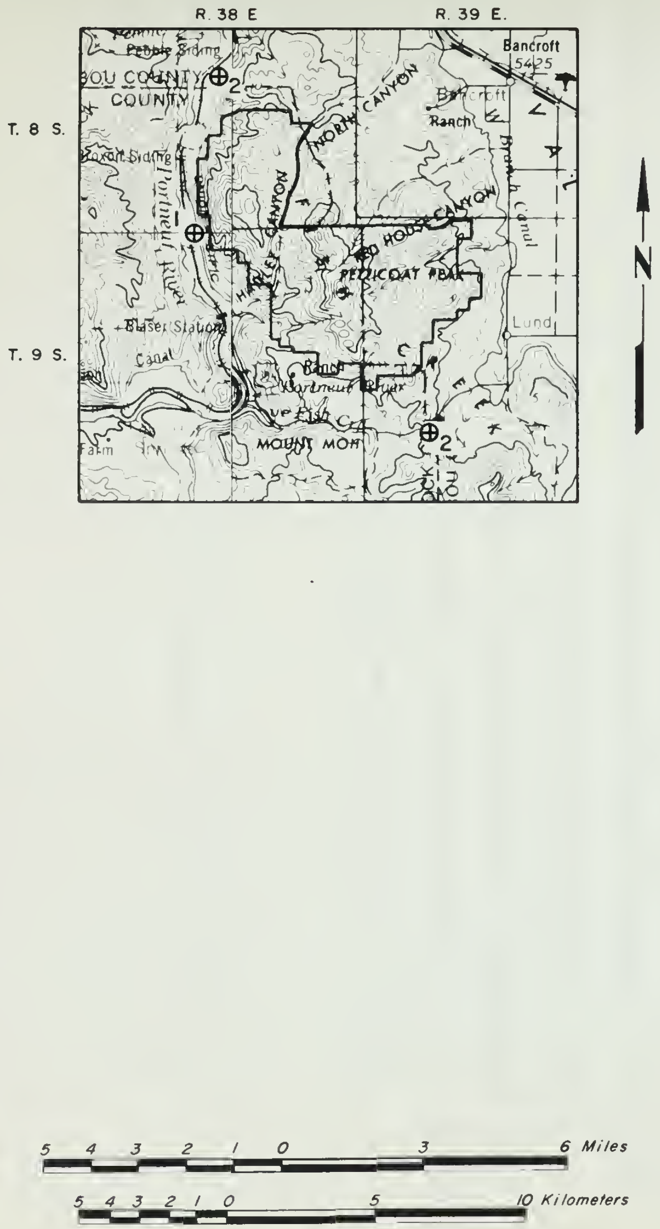
Oil and Gas Lease Status

SCALE 1"=4 MILES			FIGURE
DATA BY WGM	DATE 1/1983	REVISED	11
DRWN BY DSI	APRVD G.F.		

TABLE III

OIL AND GAS LEASES IN WSAs IN THE PETTICOAT PEAK GRA, IDAHO

WSA	Lease No.	Owner or Record	Date Issued
28-1	I 16510	Pioneer Production Co. P.O. Box 2542 Amarillo, Texas 79189	7-8-81
	I 167-7	Pioneer Production Co. P.O. Box 2542 Amarillo, Texas 79189	8-1-81
	I 16808	John R. Shaw 3435 Ramona Drive Riverside, California 92506	7-16-81
	I 17061	Thomas D. Hewitt Suite 915 Gulf Canada Square Calgary, Alberta, Canada	10-1-81
	I 17-63	Thomas D. Hewitt Suite 915 Gulf Canada Square Calgary, Alberta, Canada	9-14-81
28-1	I 17066	Thomas D. Hewitt Suite 915 Gulf Canada Square Calgary, Alberta, Canada	9-14-81
	I 17068	Thomas D. Hewitt Suite 915 Gulf Canada Square Calgary, Alberta, Canada	9-16-81
	I 18210	Raclalk Production Inc. 16800 Dallas North Parkway Suite 220 Dallas, Texas 75248	2-82



EXPLANATION

△ *Unpatented Mining Claim*

X *Patented Mining Claim*

⊕ *Material Site*

NUMBER DENOTES NUMBER OF CLAIMS OR MATERIAL SITES IN THAT SECTION.

Notes:

1.) *Area of Search: GRA*

2.) *Data Current to: Claims – June 7, 1982*
Material Sites – Aug. 8, 1982

3.) *Source of Data: BLM Claims Records and Mineral Title Plats.*

4.) *No Mining Claims Present.*

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho
Mining Claims and
Material Sites

SCALE 1" = 4 MILES (1:250,000)			FIGURE
DATA BY WGM	DATE 9/1982	REVISED	12
DRWN BY DSI	APRVD G.F		

Quarry stone, principally for use as rip-rap is abundant but use is likely to be restricted to areas of easy access such as along the highway. The Quaternary basalts, cinder fields, and quartzite units are potential source rocks. For example, the Salt Lake Formation is mined for pumice in other parts of Idaho (Asher, 1965).

Quartzite is mined for silica near Pocatello, northwest of the GRA. The WSA is underlain by several quartzite units, such as the Swan Peak Quartzite and other formations. The WSA also contains significant quantities of limestone and dolomite. Limestone is mined at Inkom for use in production of Portland Cement. No data is available concerning the chemical properties of the limestone and dolomite within the WSA. This data would be needed to evaluate any market potential it might have.

Manganese deposits are present in the Petticoat Peak GRA near Lava Hot Springs. These deposits result from interaction of oxidized hydrothermal solutions principally with dolomites and quartzites during circulation along faults. Due to the abundance of faults and geothermal activity in the area the Petticoat Peak WSA may also contain deposits of manganese. However, these deposits appear to be a near-surface phenomenon so the potential for subsurface deposits is probably limited. In addition, the deposits occur in small discontinuous pods which seriously detracts from their economic viability.

Three ore environments, in about equal amounts, host 90% of the free-world uranium reserves. These are:

1. early Precambrian quartz-pebble conglomerates,
2. sandstone-hosted roll-front deposits, mainly in post carboniferous continental sandstones, and
3. unconformity vein deposits, thus far known only in Proterozoic rocks.

Peneconcordant sandstone deposits account for about 95% of U.S. reserves. Uranium in these deposits is accompanied by iron (as pyrite if the ore is unoxidized) and in many cases by copper, molybdenum, selenium, and vanadium.

There are a few uranium occurrences in southeastern Idaho (Cook, 1955; Armstrong, 1964). The reported occurrences are: (1) in Cassia County, south of Burley, at Goose Creek and City of Rocks, and (2) in Bonneville County at Fall Creek, southeast of Idaho Falls. The Goose Creek and Fall Creek occurrences consist of uraniferous carbonaceous shale, lignite and coal (Mapel and Hail, 1959; Vine, 1959). The City of Rocks occurrences are in a uranium-bearing pegmatite and in a nearby uraniferous placer (Cook, 1957).

At the Goose Creek district thin beds of uraniferous carbonaceous shale and lignite occur interbedded with fresh water limestone, shale and bentonite in the lower part of the Pliocene Shalt Lake Formation (Mapel and Hail, 1956). The uraniferous bed averages one foot thick with a grade ranging from 0.01 to 0.12% uranium (Mapel and Hail, 1959), and the uranium minerals present are unknown. The Fall Creek prospect is similar in that uranium mineralization occurs in coal and carbonaceous shales which are interbedded with fresh water limestone and quartzite of the Cretaceous Bear River Formation (Vine, 1959). Also, the uranium is concentrated in highly carbonaceous beds

averaging 1 to 2 feet in thickness and grades range from 0.0004 to 0.131% with an average grade of 0.02% uranium (Vine and Moore, 1952).

Studies of uraniferous lignite by Breger et al. (1955) suggest that the uranium in carbonaceous rocks occur as metal-organic compounds. Vine (1959) proposed that the uranium at Fall Creek was leached from silicic volcanic rocks, in this case Miocene rhyolitic tuffs, by meteoric waters and precipitated in the carbonaceous horizons.

No uranium occurrences are known in the Petticoat Peak GRA (Cook, 1980). The deep Tertiary basin of Gem Valley six to eight miles east of the GRA, may have some potential for sandstone-hosted roll-front or Goose Creek type uranium deposits since volcanics in the Salt Lake City-Star Light Formations could be a source of uranium. Concentration of uranium by ground waters in subsurface sandy units or carbonaceous beds could produce economic deposits. Two geochemical samples were collected during the NURE program in the west part of the GRA by Cook (1980). Uranium values in both samples are not above the regional background, but the data is insufficient for an adequate evaluation of the uranium potential.

Although extensive areas of southeastern Idaho including all of the Petticoat Peak WSA, are leased for hydrocarbon exploration, no production has yet resulted. According to Breckenridge (1982) 60 hydrocarbon test wells have been drilled in southeastern Idaho, 30 of which penetrated to depths greater than 5,000 feet. Information from some of these tests is still confidential. Shows of oil and gas have been reported in a number of wells, but so far all have been plugged and abandoned. Exploration drilling

continues in the area (McCaslin, 1982). However, none have been drilled in the Petticoat Peak GRA.

The nearest commercial production to the Petticoat Peak GRA is from 16 fields approximately 65 to 120 miles southeast in the overthrust belt of northern Utah and southwestern Wyoming. This area has been developing rapidly in the past eight years (McCaslin, 1981b). It is now recognized as a major petroleum province with at least three giant oil fields. Powers (1977) estimates that between 0.6 and 3.0 billion barrels of oil and 4.0 to 12.0 trillion cubic feet of natural gas will be produced from the Idaho-Wyoming-Utah portion of the Overthrust Belt.

The earliest papers which discussed the hydrocarbon potential in southeastern Idaho were by Kirkham (1922, 1924, and 1935) and Heald (1922). In general, Kirkham suggested that potentially favorable source rocks, reservoir beds and trap-forming structures for hydrocarbon accumulations are all present in southeastern Idaho. Peterson (1977) summarized the source and reservoir characters of each geologic period for the Cambrian through Jurassic for the eastern Great Basin and western Rocky Mountain shelf. He stated:

"Favorable factors include the dominantly marine and varied lithologic facies, and the good to excellent potential source rock and shallow-water reservoir facies, associated with continuous paleostructural growth that resulted in the existence of long continuing and extensive depositional shelves and shelf-margins, along with subsiding marginal basins of deposition. Taken together, these paleogeographic-environmental factors

provide an excellent combination favoring generation and early accumulation of petroleum in several parts of the stratigraphic section, particularly the Middle to Late Paleozoic."

This statement certainly applies to the southeastern Idaho region, including the Petticoat Peak GRA.

Direct evidence which supports the possibility of hydrocarbon deposits in the Petticoat Peak GRA include: (1) the report of hydrocarbon shows in numerous test wells in southwestern Idaho, and (2) the recognition of the Phosphoria as an excellent source bed (Claypool and others, 1978; Peterson, 1980).

The Petticoat Peak GRA is within the northern extension of the Thrust Belt rocks underlying northern Utah and southwestern Wyoming. The major stratigraphic differences between the two areas are the absence of the Mesozoic section and a thicker section of Paleozoic rocks in the Petticoat Peak GRA. Thus the Nugget Sandstone, Thaynes Formation, Dinwoody Formation and some Cretaceous sandstones, all of which are major reservoir beds in the Utah-Wyoming thrust belt, are not present in the Petticoat Peak GRA. However, the Phosphoria Formation, the Wells Formation, the Madison Limestone equivalents, and Ordovician carbonates, all of which are known reservoir beds in western Wyoming, underlie the GRA at depth. Considering all the analyses and evidence for potential hydrocarbon accumulation in southeastern Idaho, the hydrocarbon resource potential for the Petticoat Peak GRA must be considered as moderately favorable.

Western Montana and southern Idaho are included in the Cordilleran Mountain Belt of western North America. Volcanic and tectonic processes have been active in these areas within the past few millions of years and there are extensive manifestations at the surface of geothermal resources. However, within this area there are quite significant geologic variations among these occurrences. In the most recent geothermal classification of the United States (Muffler, 1979), geothermal resources were divided into six categories. These are:

1. Conduction-dominated regions
2. Igneous-related geothermal systems
3a. High temperature (150°C) hydrothermal convection systems
 b. Intermediate temperature (90-150°C) hydrothermal convection systems
4. Low temperature (90°C) hydrothermal convection systems
5. Geo-pressured geothermal energy systems

For the purposes of this assessment these classes can be reduced to two: (1) high temperature (less than 150°C) hydrothermal convection systems, and (2) low/intermediate temperature (40-150°C) hydrothermal convection systems. Geo-pressured geothermal energy systems do not exist in the areas discussed. Theoretically, geothermal resources exist everywhere because the temperature of the earth's crust everywhere increases with depth. Thus, high temperatures are reached at some depth below any given point on the earth's surface. At the present time, and for the foreseeable future, a naturally occurring hot fluid coupled with sufficiently porous and permeable rocks to allow fluid migration, are prerequisites for practical use of geothermal

energy; thus, conduction-dominated and "magma-tap" geothermal systems are not included in this evaluation.

Based on present requirements for use of hot fluids in electrical generating techniques, geothermal systems with temperatures of less than 150°C do not have significant potential for electrical exploitation. These systems, however, can be considered to have a significant potential for low and intermediate temperature geothermal utilization for space heating, material processing, etc. if their minimum temperature exceeds 40°C. At the lower end of the spectrum, as the energy content of the resource becomes less, or the drilling depth necessary for exploitation becomes greater, there is a very ill-defined cutoff. For example, shallow ground water temperatures on the order of 10-20°C can be used for heat pump applications, and in some cases these are considered geothermal resources. However, for the purpose of this discussion, a lower temperature than approximately 40-60°C is considered uneconomic as for a geothermal resource. Another important economic factor affecting the viability of a geothermal resource is the distance from the source of the point of consumption. At lower temperatures it is not feasible to consider long-distance transportation of geothermal energy whereas for the electrical grade resources long transportation distances are of course feasible. It is clear that a 40°C warm spring, no matter what its flow, has relatively little resource potential if it is located 10 to 20 miles from the nearest possible spot of application. Of course, many of the warm springs in the western United States including those at Lava Hot Springs, have been used for recreational purposes regardless of location. For the purposes of this report the resources are classified in terms of observed or expected system temperature. It is not possible to evaluate the

resources within the Petticoat Peak GRA based on drilling or production testing since none has been undertaken.

There are many exploration techniques used in the exploration for, and evaluation of, geothermal systems. The most practical techniques, in order of cost and recommended application, are: geologic mapping; spring and well geochemical analysis for "reservoir" temperature determination (Ellis and Mahon, 1977); and temperature gradient/heat flow determination in existing wells and drill holes. Other geophysical techniques such as electrical resistivity, gravity, seismic studies, etc., are not specific to geothermal resources and may generate anomalies which have little or no relationship to geothermal systems. However, in specific geothermal areas, all of these techniques may be and are often used in exploration. Ball et al. (1979) present a brief discussion of exploration and reservoir assessment techniques and costs.

The geothermal provinces encompassing GEM Region 2 are shown in Table IV below:

TABLE IV

GEOTHERMAL PROVINCES IN GEM REGION 2

1. Montana Thrust/Foothills
2. Montana Basin and Range
3. Central Idaho Basin and Range
4. Idaho Batholith/Blue Mountains
5. Southeastern Idaho Basin and Range
6. Snake River Plains

The Petticoat Peak GRA is within the Southeastern Idaho Basin and Range geothermal province. This province is similar in many respects to the Central Idaho Basin and Range province, particularly with respect to the geological setting. Rocks in the mountain ranges are extensively folded and thrust faulted Precambrian and Paleozoic sedimentary rocks. The eastern boundary of the Southeastern Idaho Basin and Range province is the Wyoming Thrust Belt and/or the Wyoming Basin, but the thermal boundary is poorly determined. The Intermountain Seismic Belt (Fig. 8) runs through the province and micro- (and larger) earthquake occurrences are numerous in the area. The hydrology is complicated because of the abundance of carbonate bedrock. In contrast to the Central Idaho Basin and Range province, there are several exposures of young volcanic rocks in the Southeastern Idaho Basin and Range. An example is the extensive area of very young (less than 100,000 years old) silicic and basaltic volcanic rocks (Mitchell et al., 1980). near the Blackfoot Reservoir in the central part of the province. The province is continuous with the much more extensive classical Basin and Range province of Utah and Nevada. Heat flow values in this province are not well known but are at least as high as possibly higher than in the Montana and the Central Idaho Basin and Range geothermal provinces. Temperatures in the southeastern Idaho Basin and Range may range from 75 to 100 milliwatts per square meter. A number of deep hydrocarbon tests have been drilled in this province and very high temperatures have been reported in them from depths 2 to 2½ mi. (3 to 4 km). Geochemical data also suggest very high "base" temperatures for some of the geothermal resources in this province (Mitchell et al., 1980). However, the presence of these potential high temperature geothermal systems has yet to be demonstrated by deep

drilling. The exception, of course, is the Raft River system where experimental exploitation for electrical and other uses of 150°C water is in progress.

Because of the complicated hydrologic and tectonic setting within the Petticoat Peak GRA, it is difficult to make firm statements about its geothermal resource potential outside of general statements applying to the entire province. The lack of knowledge about the size of geothermal reservoir tapped by the Lava Hot Springs makes it impossible to be specific about geothermal resources in the GRA. In the hydrologic setting of southeastern Idaho warm water can travel several if not several tens of miles or more laterally. The distance of lateral fluid movement in the GRA can not be assessed with presently available data. Warm water could also be moving up along faults or aquifers underlying the WSA.

3.6 Mineral and Energy Economics

The principal resources of interest in the Petticoat Peak GRA are limestone, silica, pumice, manganese, oil and gas, and geothermal resources.

Limestone and dolomite have a variety of uses including aggregate, cement, lime, building stone, fluxes, glass material, refractories fillers, abrasives, soil conditioners and many others. The generally low unit value of most limestone and dolomite dictates that production and transportation cost be low (Carr and Rooney, 1975). In this light, distance to market is a major factor and the relatively undeveloped character of the Petticoat Peak GRA and the distance to major population centers would make transportation

costs prohibitively high. Use is a major factor in determining how far limestone and dolomite can be shipped. High calcium limestone (95% $CaCO_3$) and high purity dolomite (40% $MgCO_3$) have a variety of uses in the chemical and metallurgical industries since they are less common, they have a higher unit value than common grades of limestone and dolomite (Brobst and Pratt, 1973). Large reserves of Portland cement grade-limestone are present north of the GRA at Inkom. Additional research on the chemical quality of the carbonate rocks in WSA 28-1 and the regional market potential would be needed to fully evaluate the development economics for the carbonate resources in the WSA.

A potential multi-purpose industrial raw silica material must have several characteristics; including light color, at least 95% grain size between 20 and 140 mesh, and uniform grain size distribution (Murphy, 1975). The bulk of the silica raw materials used in the ceramic, refractory, and heavy chemical industries as well as the foundry, steel and metallurgical industries are supplied from quartzites and detrital quartzose sands. Silica is a relatively low-priced commodity whose cost is influenced by availability of cheap energy and convenient transportation. Southeastern Idaho and the Petticoat Peak GRA at least partially qualifies on these counts. Carter et al. (1962) evaluated silica resources in the Pacific northwest and concluded that the Bovill clay-sand deposit in Latah County, Idaho was one of the outstanding supply sites for silica in the region. In this light further evaluation of the quartzite units in the Petticoat Peak GRA may be warranted.

Pumice and pumicite are used primarily in the construction industry as road metal, railroad ballast, and building block aggregate but also as an abrasive (Peterson and Mason, 1975). Transportation is an important cost factor in the economics of the domestic pumice industry. Construction grade pumice has a low unit value whereas abrasive grade pumice as a higher price and can stand the higher cost of shipment over longer distances (Meisinger, 1980). U.S. production comes largely from the western states (Bush, 1973). Production has been sufficient to supply demand in past years, but projected increases in demand suggest that evaluation of the Salk Lake Formation in the Petticoat Peak GRA may be warranted (Meisinger, 1980).

Manganese is used primarily in the steel industry and demand is tied closely to steel production. The component of domestic manganese consumption supplied from U.S. mines is about 3% and most manganese is imported or purchased from the government stockpiles (DeHuff and Jones, 1980). Manganese is classified as a strategic mineral by the Federal Emergency Management Agency. In this context manganese mineralization in the GRA could be significant during periods of national emergency.

Government emphasis on decreasing U.S. reliance on imported oil, the recent deregulation of natural gas prices, and the overall rise in energy prices are responsible for the continued high level of exploration for oil and gas in the Overthrust Belt (McCaslin, 1982). Even small oil and gas fields, particularly in areas of well developed infrastructure such as the Petticoat Peak GRA, would be economically significant.

The economics of geothermal energy resources are difficult to assess at the present time. Thermal waters from Lava Hot Springs are being used for space heating at the present time. The economic feasibility of larger scale use of geothermal energy is being investigated at the nearby Raft River area, west of the Petticoat Peak GRA (Mitchell et al., 1980).

4.0 LAND CLASSIFICATION FOR GEM RESOURCES POTENTIAL

4.1 Explanation of Classification Scheme

In the following subsection the land in the Petticoat Peak WSA is classified for geology, energy and mineral (GEM) resource spotential. The classification scheme used is shown in Table V. Use of this scheme is specified in the contract under which WGM prepared this report.

The evaluation of resource potential and integration into the BLM classification scheme has been done using a combination of simple subjective and complex subjective approaches (Singer and Mosier, 1981) to regional resource assessment. The simple subjective approach involves the evaluation of resources based on the experience and knowledge of the individuals conducting the evaluations. The complex subjective method involves use of rules, i.e. geologic inference, based on expert opinion concerning the nature and importance of geologic relationships associated with mineral and energy deposits (Singer and Mosier, 1981).

The GEM resource evaluation is the culmination of a series of tasks. The nature and order of the tasks was specified by the BLM, however they constitute the general approach by which most resource evaluations of this type are conducted. The sequence of work was: (1) data collection, (2) compilation, (3) evaluation, and (4) report preparation. No field work was done in the Petticoat Peak WSA.

TABLE V

BUREAU OF LAND MANAGEMENT GEM RESOURCES LAND CLASSIFICATION SYSTEM

CLASSIFICATION SCHEME	LEVELS OF CONFIDENCE
1. The geologic environment and the inferred geologic processes do not indicate favorability for accumulation of mineral resources.	A. The available data are either insufficient and/or cannot be considered as direct evidence to support or refute the possible existence of mineral resources within the respective area.
2. The geologic environment and the inferred geologic processes indicate low favorability for accumulation of mineral resources.	B. The available data provide indirect evidence to support or refute the possible existence of mineral resources.
3. The geologic environment, the inferred geologic processes, and the reported mineral occurrences indicate moderate favorability for accumulation of mineral resources.	C. The available data provide direct evidence, but are quantitatively minimal to support or refute the possible existence of mineral resources.
4. The geologic environment, the inferred geologic processes, the reported mineral occurrences, and the known mines or deposits indicate high favorability for accumulation of mineral resources.	D. The available data provide abundant direct and indirect evidence to support or refute the possible existence of mineral resources.

4.2 Classification of the Petticoat Peak (28-1) Wilderness Study Area

4.2.1 Locatable Minerals

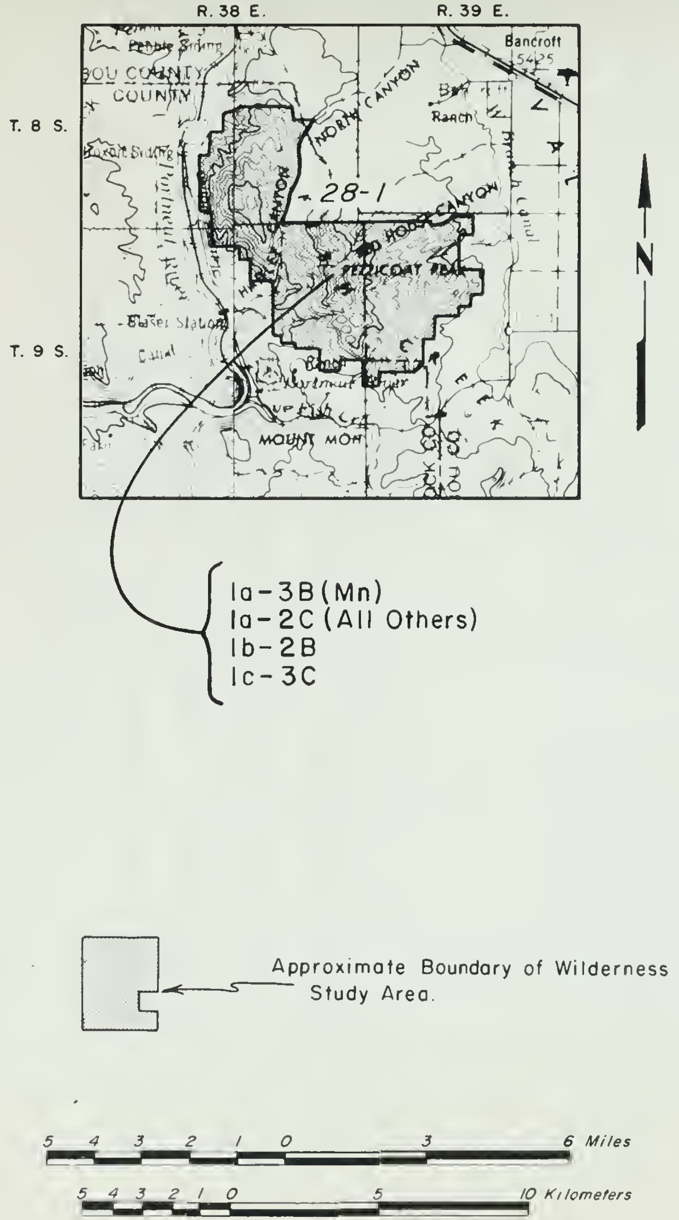
Locatable minerals are those which are locatable under the General Mining Law of 1872, as amended, and the Placer Act of 1870, as amended. Minerals which are locatable under these acts include metals, ores of metals, nonmetallic minerals such as asbestos, barite, zeolites, graphite, uncommon varieties of sand, gravel, building stone, limestone, dolomite, pumice, pumitice, clay, magnesite, silica sand, etc. (Maley, 1983).

4.2.1a Metallic Minerals. The entire area of WSA 28-1 (1a, Fig. 13) is classified as having moderate favorability for occurrence of subsurface manganese deposits based on indirect evidence (3B). The basis of the classification is the general similarity of the geology in the WSA with that of the Lava Hot Springs area which contains the Vanza manganese deposit. The low level of confidence is assigned because of the lack of occurrences in the WSA and the apparent near-surface nature of the known deposits.

The entire area of the WSA is classified as having low favorability for other metallic minerals based on the geologic environment and the lack of any known deposits in the area.

4.2.1b Uranium and Thorium. All of WSA 28-1 (1b, Fig. 13) is classified as having low favorability for uranium and thorium based on indirect evidence (2B). The predominantly marine character of the rocks underlying the WSA is not a very favorable environment for uranium deposition.

BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES



CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION

I a - 4D

I — Area I.D. Number
a — Commodity
4 — Classification
D — Level of Confidence

a) Metallic Minerals
b) Uranium and Thorium
c) Non-Metallic Minerals

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho
Wilderness Study Area
Land Classification
Locatable Resources

SCALE 1" = 4 MILES (1 250,000)			FIGURE
DATA BY. WGM	DATE 9/1982	REVISED	13
DRWN BY DSI	APRVD G F		

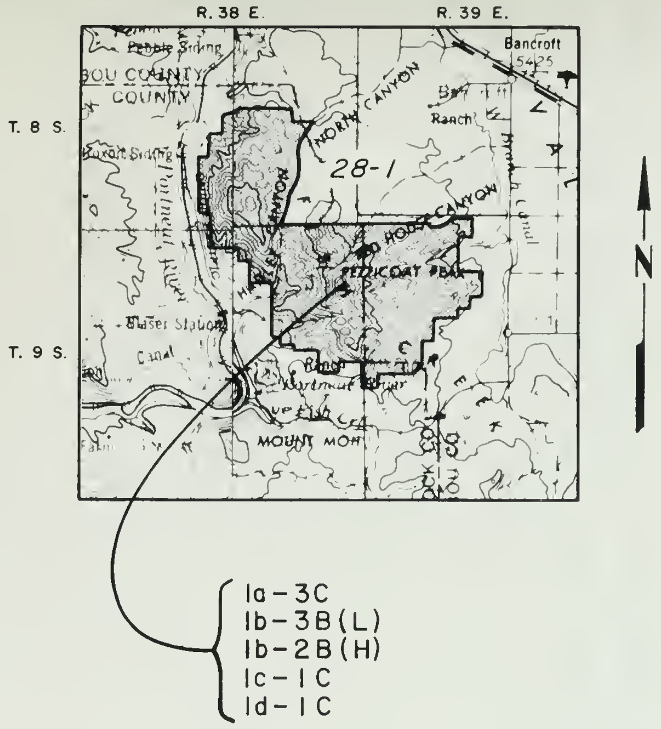
4.2.1c Non-Metallic Minerals. All of WSA 28-1 (1c, Fig. 13) is classified as having moderate favorability for the occurrence of uncommon varieties of limestone and silica based on limited direct evidence (3C). The portion of the WSA underlain by Salt Lake Formation is similarly classified for the occurrence of pumice and pumicite.

4.2.2 Leasable Resources

Leasable resources include those which may be acquired under the Mineral Leasing Act of 1920 as amended by the Acts of 1927, 1953, 1970, and 1976. Materials covered under this Act include: asphalt, bitumen, broates, and sodium and potassium, carbonates of sodium and potassium, coal, natural gas, nitrates of sodium and potassium, oil, oil shale, phosphate, silicates of sodium and potassium, sulfates of sodium and potassium, geothermal resources, etc. (Maley, 1983).

4.2.2a Oil and Gas. WSA 28-1 (1a, Fig. 14) is classified as having moderate favorability for the occurrence of oil and gas resources based on limited direct evidence (3C). The basis of the classification is outlined in Section 3.5.

4.2.2b Geothermal. The entire area of WSA 28-1 (b1, Fig. 14) is classified as having moderate favorability for low to intermediate temperature geothermal resources based on indirect evidence (3B) and as having low favorability for high temperature geothermal resources based on indirect evidence (2C). The proximity of the WSA to known geothermal resources at Lava Hot Springs forms the basis of this classification.



▭ Approximate Boundary of Wilderness Study Area.

BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.
4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

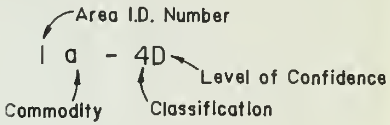
A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION



a) oil and gas

b) Geothermal: high temperature (H), Low temperature (L)

c) Sodium and Potassium

d) others: Asphalt (As) bitumen (bt), phosphate (ph), No specific commodity designation indicates that the rating applies to all of the above.

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho

Wilderness Study Area
Land Classification
Leasable Resources

SCALE 1"= 4 MILES (1 250,000)			FIGURE
DATA BY WGM	DATE 9/1982	REVISED	14
DRWN BY DSI	APRVD G.F		

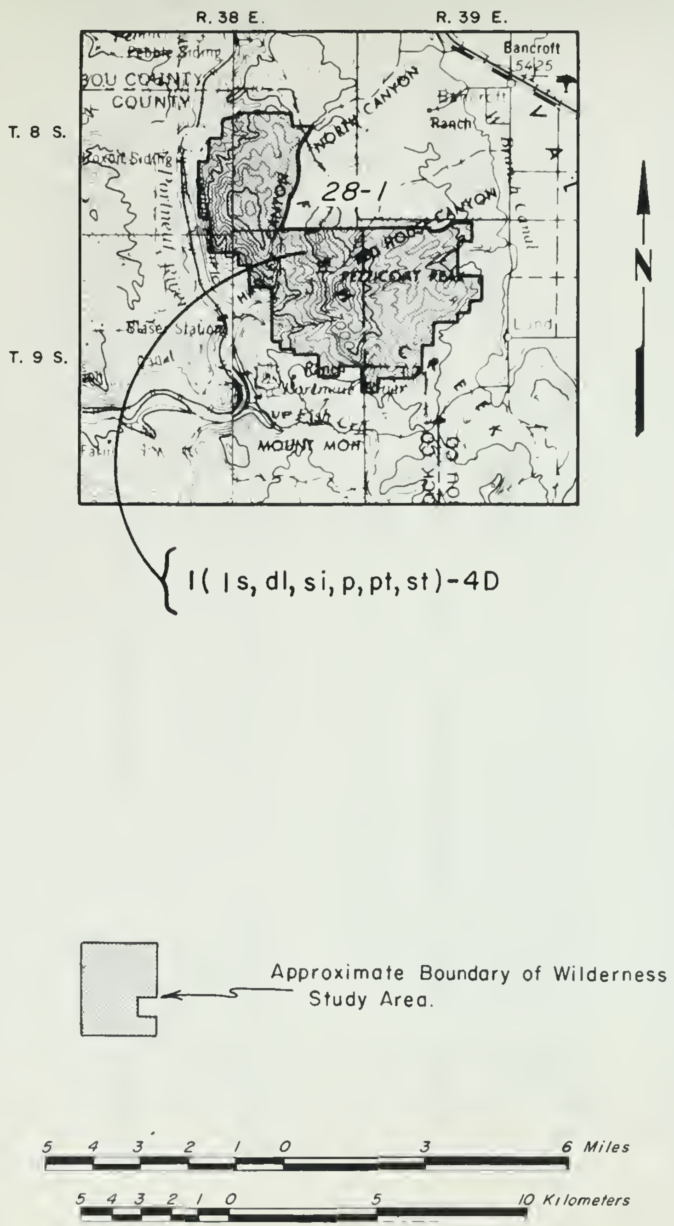
4.2.2c Sodium and Potassium. WSA 28-1 (1c, Fig. 14) is classified as unfavorable for the occurrence of sodium and potassium based on limited direct evidence (1C). This classification is due to the predominantly marine nature of the rocks underlying the WSA and the regional absence of occurrences in this environment.

4.2.2d Other. WSA 28-1 (1d, Fig. 14) is classified as unfavorable for the occurrence of other leasable resources including asphalt, bitumen and phosphate based on limited direct evidence (1C).

4.2.3 Saleable Resources

Saleable resources include those which may be acquired under the Materials Act of 1947 as amended by the Acts of 1955 and 1962. Included under this Act are common varieties of sand, gravel, stone, cinders, pumice, pumicite, clay, limestone, dolomite, peat and petrified wood (Maley, 1983).

WSA 28-1 (1, Fig. 15) is classified as highly favorable for common varieties of limestone, dolomite, silica, pumice, pumicite and stone based on direct evidence (4D).



BLM LAND CLASSIFICATION SYSTEM FOR GEM RESOURCES

CLASSIFICATION SCHEME

1. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES DO NOT INDICATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

2. THE GEOLOGIC ENVIRONMENT AND THE INFERRED GEOLOGIC PROCESSES INDICATE LOW FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

3. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, AND THE REPORTED MINERAL OCCURRENCES INDICATE MODERATE FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

4. THE GEOLOGIC ENVIRONMENT, THE INFERRED GEOLOGIC PROCESSES, THE REPORTED MINERAL OCCURRENCES, AND THE KNOWN MINES OR DEPOSITS INDICATE HIGH FAVORABILITY FOR ACCUMULATION OF MINERAL RESOURCES.

LEVELS OF CONFIDENCE

A. THE AVAILABLE DATA ARE EITHER INSUFFICIENT AND/OR CANNOT BE CONSIDERED AS DIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES WITHIN THE RESPECTIVE AREA.

B. THE AVAILABLE DATA PROVIDE INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

C. THE AVAILABLE DATA PROVIDE DIRECT EVIDENCE, BUT ARE QUANTITATIVLEY MINIMAL TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

D. THE AVAILABLE DATA PROVIDE ABUNDANT DIRECT AND INDIRECT EVIDENCE TO SUPPORT OR REFUTE THE POSSIBLE EXISTENCE OF MINERAL RESOURCES.

EXPLANATION

$$\overset{\text{Area I.D. Number}}{\underset{\text{Commodity}}{1(\text{ls})}} - \underset{\text{Classification}}{4}\overset{\text{Level of Confidence}}{D}$$

s	Sand
g	Gravel
st	Stone
c	Cinders
p	Pumice
pt	Pumicite
cl	Clay
ls	Limestone
dl	Dolomite
P	Peat
pw	Petrified wood
si	Silica

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BLM GEM RESOURCES ASSESSMENT
REGION 2 NORTHERN ROCKY MOUNTAINS

Petticoat Peak GRA, Idaho
Wilderness Study Area
Land Classification
Saleable Resources

SCALE 1"=4 MILES (1:250,000)			FIGURE
DATA BY WGM	DATE 9/1982	REVISED	15
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5.0 RECOMMENDATIONS FOR FURTHER WORK

Geochemical sampling should be done over the entire WSA to complete the data base and upgrade the confidence of the classifications. The sampling should consist of (1) stream sediment samples at a density of 2-3 per square mile and (2) rock geochemical sampling of all known fault zones. The lithogeochemical sampling should detect any leakage halos due to subsurface manganese mineralization.

The manganese deposits at Lava Hot Springs should be examined to determine the ore controls and provide a better model for evaluation of the WSA.

The Salt Lake Formation should be examined and the quality of the pumice evaluated. Carbonate and quartzite units underlying the WSA should be sampled to determine their quality.

The hydrocarbon potential of the WSA could be evaluated further as follows:

A. Potential source beds other than the Phosphoria should be characterized and analyzed for thermal maturity. This will indicate the types of hydrocarbons to be found in the area and delineate those horizons where burial depths have removed hydrocarbons.

B. Conodont color alteration studies should be made from the Paleozoic and Triassic limestones and shales. This will also indicate the types of hydrocarbons to be found and horizons where burial depths have been excessive.

C. Seismic surveys should be made of the area. This will help pinpoint potentially favorable structures at depth, subplates if present, and locate the most favorable drill sites.

A complete geothermal evaluation of the Petticoat Peak WSA would include the determination of whether or not the Lava Hot Springs system underlies the WSA and whether other possible systems may exist either as shallow warm water or deeper hot water systems . A hydrologic study of the WSA including a geochemical study of any springs within the Petticoat Peak GRA would be necessary. The direction of regional subsurface water flow, particularly between the Portneuf Valley and the Portneuf River needs to be investigated. Drilling of 500-1,000 foot holes for geothermal gradient studies in and around the WSA are also necessary. At least 5-10 holes would be required for successful evaluation. The holes must be deep enough to effectively test the deep geothermal regime and one or two more 4,000 foot holes might be required to test the usefulness of the shallow data. If any hydrocarbon exploration wells are drilled in the vicinity, temperature measurements should be made in such holes.

The airborne radiometric data for the region (Texas Instruments, 1979) should be examined to upgrade the confidence of the uranium evaluation.

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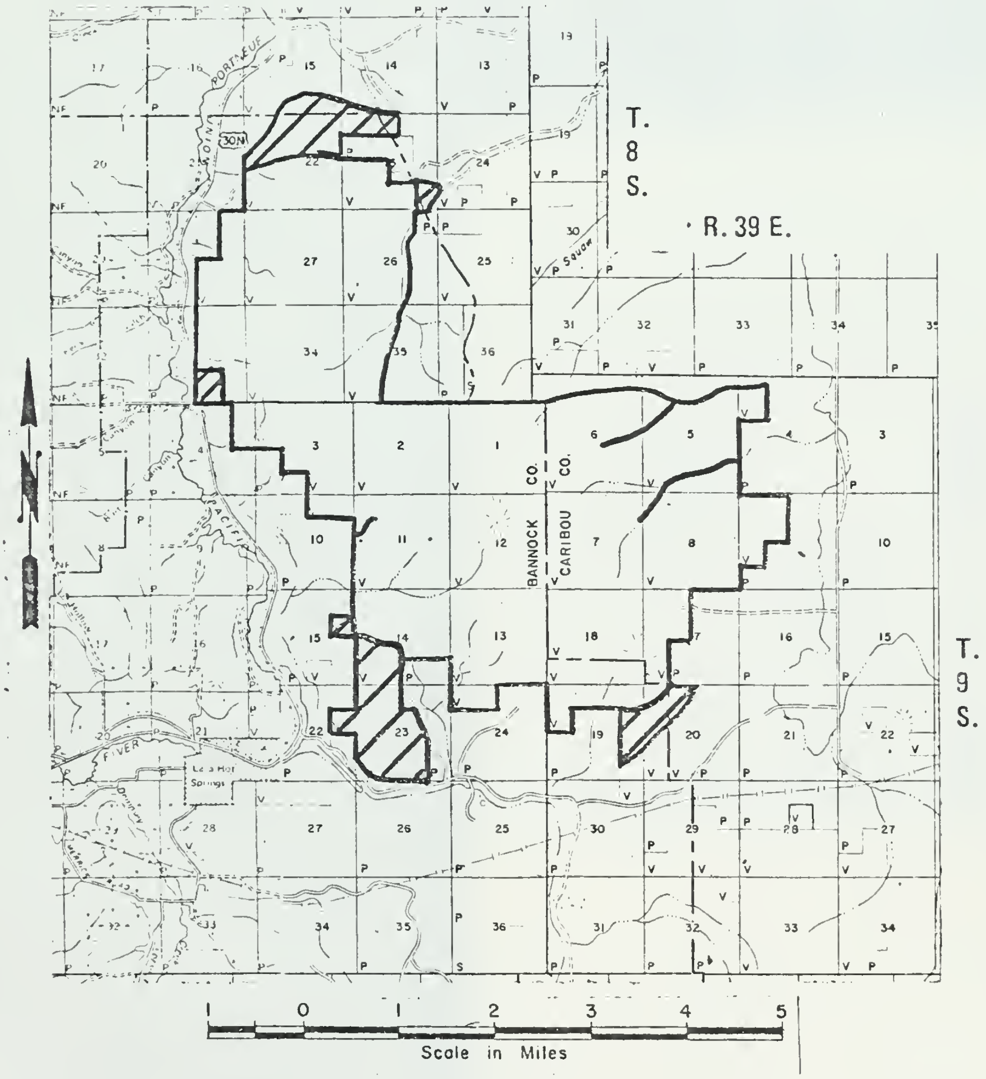
APPENDIX I

WILDERNESS STUDY AREA MAP

28–1
PETTICOAT PEAK



LEGEND

⬭ WILDERNESS STUDY AREA

▨ AREA WITHOUT CHARACTERISTICS

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